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MARKETING LIQUID SUGAR

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SUMMARY

Liquid sugar is an alternative method of marketing sugar, which gives cost-savings advantages of time, space, material, and labor to producers and users of sugar in many industrial processes. Handling sugar in liquid form permits the use of tanks, pumps, and piping to store and move it. In a typical truck-loading operation, a ton of sugar in this form is handled in approximately one-fifth the man-hour time required for unloading a ton of bagged sugar. Storage of liquid sugar in tanks permits floor-to-ceiling use of warehouse space, and frequently tanks can be placed in warehouse space not convenient for other uses.

The labor for handling liquid sugar is largely a matter of controlling mechanical devices. The final packaging operation and the cost of individual containers and their storage and disposal by the user are eliminated. Marketing sugar in bulk liquid form gives the industrial user the advantage of receiving his sweetening ingredient in a form ready for use without further processing or physical handling. The liquid is readily substituted for dry sugar in processes in which a sirup of sugar and water is required; it is adaptable, for formula adjustment, to other processes that require water as an ingredient, and also can be used advantageously in some processes when the water has to be removed. In the latter process the cost of removing the water is less than the savings realized from advantages of using liquid sugar.

Liquid sugar has uses by all the major categories of industrial sugar buyers. Bakers, bottlers, confectioners, sirup blenders, and fountain extract makers, makers of dairy products, ice cream, and sherbet, and food processors in the fields of canning, preserving, jelly and jam making, food freezing, and condiment and sauce making have all found useful applications for liquid sugar in making their products.

Commercial distribution of liquid sugar began in the late 1920's. Offshore areas (Cuba and the Dominican Republic) became important supply sources because of favorable tariff and export conditions. In addition, liquid sugar was made from raw crystalline sugar at United States refineries. The 1952 distribution of liquid sugar amounted to 691,026 tons of solids, refined basis, and approximately 5 percent of this quantity is imported from offshore areas.

Several limiting factors affect the distribution and use of liquid sugar. They are as follows:

(1) The length of the safe storage period, under practical sanitary precautions, of about 6 weeks for 67° Brix types, combined

with the economics of distribution, which dictate the size of load that can be feasibly handled, set the lower limits of annual use at the equivalent of approximately 200,000 pounds a year per user.

(2) Processing and final product limitations in the user's plant sometimes make use of dry ingredients necessary.

(3) Freight costs for liquid sugar are computed at dry sugar rates, thus making this cost one and one-third to one and one-half times the freight cost for dry sugar, as the weight of the water solvent is included in the freight rate computation.

(4) Sources for distribution of liquid sugar are concentrated in the areas of heavy industrial demand; therefore, many possible users in areas at a distance from a production point are unable to purchase liquid sugar at a price competitive with that for dry sugar because of the freight rate disadvantage.

Liquid sugar can be produced from any sugar source. It is made commercially from both cane and beet sugar. Liquid sugar from cane sugar is made by the concentration of clarified char liquor in regular raw-sugar refining processes. Beet processors make it by remelting refined beet sugar, as their process requires final crystallization before a pure sucrose is obtained. A third process, using ion-exchangers and activated carbon, also is used to produce liquid sugar from raw-cane sugar.

A large number of industrial types of liquid sugar are commercially marketed. They are generally classified in terms of color, ratio of sugar solids to water, and ratio of sucrose to invert sugar. The colorless minimum-sucrose type with a Brix of 67° is produced in the largest volume.

Cost savings in the user's plant through substitution of liquid for dry sugar are highly variable. Experiences of those contacted in the survey of industrial users indicated this variation in savings to be from a few cents to as much as $16 a ton. The average in-plant savings for those users contacted were $2.91 a ton of sugar. In addition to savings in physical handling costs, liquid sugar is priced at a differential under the standard price for dry granulated cane sugar in 100-pound paper bags. This differential generally amounted to 15 cents a hundred pounds in 1950, and has since been reduced to 10 cents by many producers.

The amount of savings realized by individual users was found to be dependent on the number of handling and processing steps eliminated or reduced by the introduction of liquid sugar. Processing

steps most frequently eliminated by users, in addition to the bag-handling operations were:

(1) Melting sugar and filtering the sirup for use;
(2) Moving sirup to points of use;
(3) Measuring sugar sirup for batches, or weighing dry sugar for making batch lots of sirup;
(4) Cooling sirup before use in processes;
(5) Inversion of sucrose sirup;
(6) Filtration or treatment of water for making sirup.

The industrial user who is considering installing a liquid-sugar facility should appraise the effects that it would have on his own processes and estimate the resultant savings. This estimated saving, plus the differential in price, must be more than equal to the difference in freight cost for liquid and dry sugar in order to amortize the investment in the facility through savings in costs of raw materials and processing.

Potential market development determinations for liquid sugar were made by comparing 1951 distribution of liquid sugar to 1947 purchases of all sugar by those industries who could feasibly use liquid sugar (due to type of product and volume of annual sugar purchases for each establishment) if it were available to them. By this method of determination, the potential market, in terms of area and type of product, is, as yet, largely undeveloped. Opportunity for expansion exists, both for present sources of liquid sugar and for new redistribution points that may be established in areas of heavy potential demand. Each major industrial use category offers an undeveloped potential market equal to two to five times its 1951 use of liquid sugar. By regions, the North Central and Southern regions of the United States have the largest undeveloped potential market for liquid sugar. These two regions, of the five considered, also offer the greatest obstacles to further development because of dry sugar competition, scattered users, and distance from liquid-sugar production points.

MARKETING OF LIQUID SUGAR

By Frederick J. Poats, Agricultural Economist,
Production and Marketing Administration

INTRODUCTION

Purpose and scope of the study

This report presents an analysis of the marketing of liquid sugar in the United States. The study is one of a number about the marketing of sugar, sugarcane, and sugar beets in the domestic sugar-producing and -consuming areas of the United States. The over-all research project, the primary objective of which is to determine the possibilities for increasing efficiency in the sugar marketing structure is being conducted by the Sugar Branch, Production and Marketing Administration, U. S. Department of Agriculture.

Industrial sugar users now take more than one-half of domestically consumed sugar supplies. A trend toward a greater volume of bulk shipments of sugar in liquid form from refiners to industrial users has been in progress for several years, and with greatly accelerated impetus since World War II. Widespread adoption of this handling method appears to offer possibilities for decreasing the costs of sugar marketing and handling. In addition to possible savings, increased use of liquid sugar may have significant effects on the production and marketing practices of the industry. Considerable interest has been expressed in the nature and extent of savings from the use of liquid sugar, the proportion of total sugar use to which it may expand, and the possible effects that maximum expansion of use will have on the sugar industry and its existing marketing practices.

This study was made to determine costs of handling liquid sugar from the refiner to the user, and in-plant savings realized by users. A measure of maximum market potential for liquid sugar has been estimated by comparing present distribution data with total sugar use in industries suited to liquid sugar. Also, attention has been given to advantages other than costs, as well as the disadvantages, of using liquid sugar, and the competitive relationship between liquid sugar and other sweeteners. The marketing of sugar in dry-bulk lots also is discussed. This information is prepared particularly for liquid-sugar producers and users, both present and potential, and, it is hoped, will be an aid in a more orderly transition to the newer technology of bulk handling.

Sources of information

Personal-interview surveys were made of all of the 16 producers of liquid sugar in the United States. 1/ The analyses of marketing methods and practices, and costs of handling liquid sugar between producers and users are based on data obtained from these producers.

Data on facilities, handling, and use of liquid sugar in the users' plants are based on personal-interview surveys of a small number of users, 55 in all. For sampling users, the United States was divided into three parts; (1) eastern, (2) middle-western and southern, and (3) western. Coverage was limited to contacts in each part of the United States with 1 small, 1 medium and 1 large user of liquid sugar from each of 8 major categories of end-product made from liquid sugar. The size groupings were 0 to 2,999 bags, 3,000 to 8,999 bags, and more than 9,000 bags of sugar used a year. Not all categories and sizes of users were found in each part of the United States; therefore 17 interviews are lacking from a complete coverage on this basis.

The survey of users of liquid sugar did not cover a sufficiently large group to make the data and observations obtained representative of all users in any one locality or type of end-product. However, they are a random-selected group from the total, and discussions for this phase of the study are limited to the conditions found among the sugar users actually contacted. This series of case studies, as a group, provides data and experiences valuable to the understanding and appraisal of the sugar-user situation throughout the industry. Other data presented are from trade publications, from reports of the Sugar Branch and published material available in that Branch, and from the 1947 Census of Manufactures by the Bureau of the Census.

History of liquid sugar use

Every time a solution of sugar and water is prepared as an ingredient in a process, the sirup is, in simplest terms, liquid sugar. For many years, this sirup-making was an integral part of processing whenever a sweetener in sirup form was required as an ingredient in the manufacture of a product.

The growth in distribution and use of liquid sugar has resulted mainly from the realization by some individuals of the possibility of

1/ All producers operative during 1951. Amalgamated Sugar Company has since installed facilities at Portland, Oreg., for remelting crystalline beet sugar. See Food Engineering, Vol. 24 No. 10-October 1952 "Bulk Sugar Service" by J. R. Grantham, Engineer, Amalgamated Sugar Co., and C. R. Havighorst, Associate Editor, Food Engineering.

delivering sugar in a form suitable for direct use, with resultant advantages of "flow" processing methods. Growth of large scale industrial usage, replacing use of sugar by home and small scale business enterprises further contributed to this development. Liquid sugar is not a new product, but rather a change in form of product marketed. The traditional marketing system involving crystalline sugar in barrels, or cloth or paper bags requires hand labor for the repeated handling and stacking operations. For liquid sugar, the unit is a tank truck or tank car load of 1,500 to 3,000 or 8,000 to 12,000 gallons, and the loading or unloading requires the labor of one man, and for a shorter period of time.

The first commercial sugar refinery for preparing and distributing bulk liquid sugar was put into operation in Brooklyn, N. Y., in 1927. For a decade, growth of the domestic liquid sugar industry was slow, partly because most industrial sugar users were reluctant to change from dry sugar, and partly because imports of liquid sugar offered certain advantages over domestic production. Opportunity to acquire liquid sugar from the offshore areas, namely Cuba and the Dominican Republic, with subsequent lower processing and handling costs, plus a differential on sugar duty, made those areas an important source of raw material. By the mid-thirties, imports reached levels as high as 16 million gallons a year from these areas. The import situation focused widespread attention on the substitutability of liquid sugar for the higher-priced dry sugar. Liquid sugar was brought under full Sugar Act 2/ recognition and control as was dry sugar.

Although the liquid sugar now being marketed in the United States is generally above 98 percent purity, legal descriptions relative to imports apply to non-crystalline sugar of 6 percent or less of soluble nonsugar solids. There is no strict line of demarcation between the various sirups composed of sugars and nonsugars. Many of the purchasers of sirups of low sugar purity are interested in the sweetening ability of the sirups as well as their flavor and other factors. The eventual development of suitable nomenclature and grades and standards for sirups and liquid sugars of varying percentages of nonsugar solids will help to eliminate many of the problems and misunderstandings that have arisen in the past.

Growth of the liquid sugar distribution industry was hampered by the depression of the 1930's, and later by the scarcity of essential metals for tanks and piping materials during World War II. The greatest acceleration in use of liquid sugar has occurred since 1945, when its use spread to the west coast, particularly to its large fruit canning industry, and expansion was accelerated also on the east coast. Several

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2/ The Sugar Act of 1937. This act is a governing instrument for establishing quotas for domestic production and imports of sugar. It embodies the principal provisions of the Jones-Costigan Act of 1934 which provisions have been reenacted since 1937; the Sugar Act of 1948, as amended, will be in effect until 1956.

smaller refineries were built in the Midwest specifically to manufacture liquid sugar, and liquid facilities were installed at some factories in the eastern beet sugar area. These new production points expanded distribution of liquid sugar in the Midwest outside the Chicago metropolitan area, where one producer has sold liquid sugar for a number of years.

Total U. S. liquid sugar distribution for 1952 amounted to 691,026 tons, solids refined basis. This figure includes imports from offshore areas and domestically produced liquid sugar. Under the 1948 Sugar Act quotas, 8,801,452 wine gallons of liquid sugar having 72 percent sugar content were imported from Cuba and the Dominican Republic. This quantity was increased by the amended act to 9,101,452 wine gallons, effective January 1, 1953, by an import allotment of 300,000 wine gallons from the British West Indies. This liquid sugar is partially inverted before shipment and is one of the principal sources in the East and Great Lakes areas.

PRODUCTION OF LIQUID SUGAR

Nature of liquid sugar

In the Sugar Act of 1948, as amended, liquid sugar is defined as follows: "The term liquid sugar means any sugars (exclusive of sirup of cane juice produced from sugarcane grown in continental United States) which are principally not of crystalline structure and which contain, or which are to be used for the production of any sugars principally not of crystalline structure which contain soluble nonsugar solids(excluding any foreign substance that may have been added or developed in the product) equal to 6 percentum or less of the total soluble solids." 3/

The bulk of liquid sugar marketed by U. S. producers has a much lower content of nonsugar solids 4/ than the upper limitation set by the Sugar Act. Table 1 shows the range of quality (chiefly measured in terms of color, solids content, and invert sugar) for the bulk of liquid sugar now sold in the United States. It also illustrates the more common types of sucrose 5/, and invert 6/ liquid sugars which constitute the principal industrial types.

3/ Sugar Act of 1948, as amended, Title I, Section 101.

4/ Soluble nonsugar solids may be any of a number of substances not removed during the refining process. Organic substances and soluble minerals are the principal constituents found in the soluble nonsugar solids. Undissolved solid matter similar to dust particles are not included in this definition.

5/ Sucrose (Syn. saccharose, beet sugar, cane sugar) is the compound commonly referred to as "sugar". Its formula $C_{12}H_{22}O_{11}$ indicates its composition to consist of 12 atoms of carbon combined with the equivalent of 11 molecules of water (H_2O).

6/ Invert sugar is the most common trade usage name for a mixture composed of equal parts of dextrose and levulose. Levulose and dextrose have the formula $C_6H_{12}O_6$. Invert sugar is prepared by splitting the sucrose molecule into two parts with a simultaneous addition of one molecule of water.

Table 1.--Commercial types of liquid sugar

Factor	First quality	Lower quality
SUCROSE TYPE		
Total solids content--------- percent	66 to 67	66 to 67
Invert sugars-------percent of solids	0.1 to 0.3	0.2 to 1.0
Color	Colorless	Very pale amber to amber
LOW INVERT TYPE		
Total solids content----------percent	66 to 69	66 to 69
Invert sugars-------percent of solids	2 to 20	5 to 20
Color	Colorless	Very pale amber to amber
MEDIUM INVERT TYPE		
Total solids content----------percent	74 to 79	74 to 79
Invert sugars-------percent of solids	20 to 75	20 to 75
Color	Colorless to amber	Amber to dark amber
HIGH INVERT TYPE		
Total solids content----------percent	70 to 77	70 to 77
Invert sugars-------percent of solids	75 to 99	75 to 99
Color	Amber	Amber to dark amber

Note: These are general descriptions of each type and do not necessarily agree with the characteristics of liquid sugars marketed by any one company. They are given as prototypes to include the bulk of liquid sugar sold in the entire United States.

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The liquid sugars in greatest use are the first quality sucrose type and the first quality low-invert type from the ion-exchange process. These are the principal substitutes for dry crystalline sugar, and they may be used in processes in which the dry sugar ingredient has to be melted into a sirup with water before being added to the process. The invert types constitute somewhat more of a specialty sugar. Invert sugar gives attributes other than sweetness to substances in which it is used. In addition to being rated slightly sweeter than sucrose, it is hygroscopic (ability to absorb moisture from the surrounding air); it is more soluble than sucrose (one component, levulose, is very highly soluble in water); because of its greater molecular concentration per pound relative to sucrose 7/, it has a lower freezing point in water solutions; and, through its physiochemical action, it is requisite to raising of dough and browning and crust formation of breads and cakes.

Many tests of these and other properties have been made and are discussed in technical literature relative to each process. For this reason, these tests will not be discussed in detail in this report.

Other characteristics generally common to all types of commercially distributed liquid sugar, in addition to those listed in table 1, are: (1) Above 98 percent purity, (2) no visual turbidity (dust-like particles in suspension in the solution), and (3) neutral or slightly acidic reaction (pH ranges from approximately 4.5 to 7.0). Most liquid sugars are marketed at maximum concentration of sugar solids without recrystallization at ordinary temperatures. Some "tailor-made" liquid sugars are below this Brix value, but, as indicated, are prepared for specific uses. As 40 to 60 percent ratios of invert and sucrose have the highest solubility, the medium invert types have the highest Brix values of the various liquid-sugar types.

Commercial methods of producing liquid sugar

Liquid sugar can be produced from any sucrose source. It is made commercially from both cane and beet sugars, the largest source at present being raw cane sugar. Refining methods vary slightly in different areas, the method used depending on the source of sugar and the nature of market demand for liquid sugar.

7/ By formulated definition in footnote 6, two molecules, dextrose and levulose, formed from each sucrose molecule, double the molecular concentration. Freezing point depression of water solutions of sugars are related to the number of molecules of substance per unit volume of solution. Doubling of molecule numbers by inversion of sucrose to dextrose and levulose therefore will depress the freezing point further.

Raw cane sugar is processed in the usual manner required for making refined crystalline sugar, with the exception of the final recrystallization. Instead of this step, the sugar liquor is concentrated by evaporation to the desired Brix value for liquid sugar, and then stored ready for use. 8/

A second process, called the ion-exchange method, is used principally in the midwestern refineries. In this, raw sugar liquor is subjected to the action of anion and cation exchangers and of activated carbon which remove the impurities from the sirup.

Liquid sugar also is made by melting refined sugar and inverting if necessary. Beet-sugar processors must use this process, as beet-sugar refining requires processing to the final crystals before desired purity is attained. This method also is followed by producers who use cane sugar as a material, at times when market demand is greater during a peak period than refining facilities can handle.

Additional facilities required for producing and marketing liquid sugar

The interviews with producers of liquid sugar revealed some of the changes and adjustments that have been necessary with the advent of liquid-sugar marketing. Before liquid sugar was developed, cane-sugar refineries were equipped to produce, store, and deliver a dry product in packaged form. In order to produce and market liquid sugar, storage tanks, draw-off stations, extra laboratory facilities and personnel, and remelt stations for beet-sugar factories had to be added to present refining facilities. To take care of sales and deliveries, tank trucks, weighing stations and pumps with meters were required. Investment in this equipment was higher per unit than for similar equipment for handling dry sugar. The tank truck and tank trailer were cited as examples. A tank of stainless steel with motor-driven pump and meters mounted on a semitrailer costs more than $18,000. A semitrailer for handling bag sugar costs about one-third of this amount, and the cost for a bulk bin-type truck for dry sugar, with a hydraulic lift for dumping, was about $16,000.

8/ When invert liquid sugar is desired, this is done with acid hydrolysis of the sucrose liquor during evaporation. After neutralization of the acid, the invert sirup is blended with sucrose-type liquid sugar to yield the specific invert-sucrose ratio desired. Inversion can also be accomplished by enzymes - the enzyme most frequently used is invertase. Inversion by enzymes is more expensive than acid hydrolysis and is used only when the salts resulting from acid hydrolysis and neutralization must be avoided.

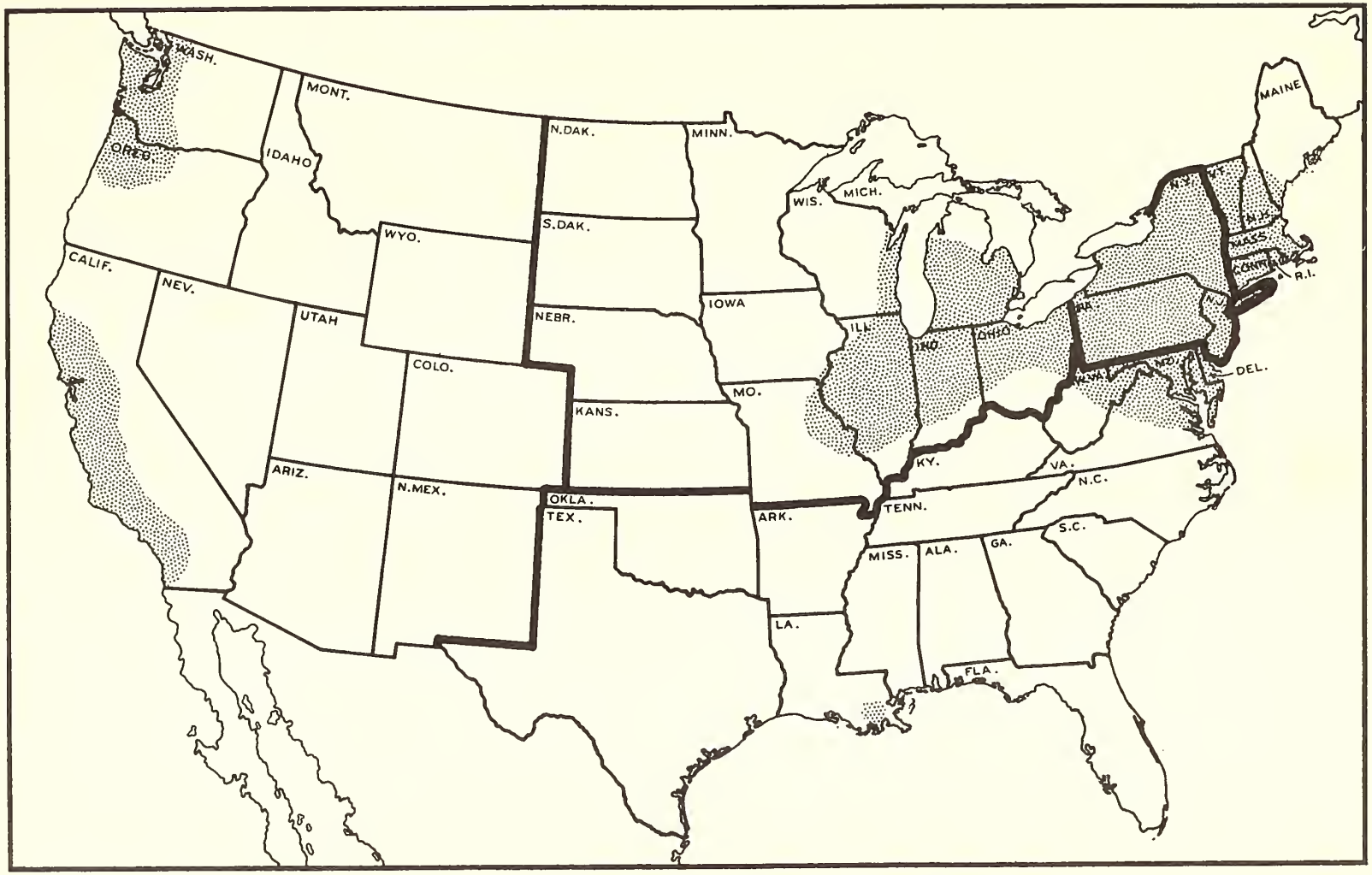
Producers also pointed out differences between the nature of demand for liquid sugar and for dry sugar. A dry sugar user can vary his inventory more, storing sugar in anticipation of use by varying the amount of space devoted to sugar storage; even renting additional storage if it is required. The liquid user is limited by the size of his storage tanks for inventory holding, and if his tanks are small in relation to rate of use, replacement of sugar must be made at frequent intervals. A user having tank storage capacities only slightly larger than delivery loads must have supplies renewed as soon as space is available. This is particularly true of the user having a 3,500- to 5,000-gallon storage with a rate of use of 500 to 800 gallons a day. To receive full load of 3,000 gallons, he must wait until the tank is almost empty before refilling it. Then, prompt service is required. This situation is found particularly among users in the East.

To meet the demand of such users, the producer must have an excess capacity for delivering liquid sugar, keeping some of his trucks on a standby basis. Delivery facilities are maintained by some producers at about one and one-half times the normal demand requirement, in order to give prompt service to all their customers.

Excess capacity above the average demand is required also in areas in which there are peak demand periods. This is true particularly on the West Coast, where, during the third quarter of the year, the canning industry buys as much as is bought in all the rest of the year by all other liquid sugar users. This peak season taxes the producer to the limits of production and delivery capacity, frequently requiring extra production and delivery service shifts, renting of tank trucks to supplement company-owned equipment, and quick service for railway deliveries.

Excess capacity requirements, which are different in each area, were pointed out by producers as one of the principal complicating factors affecting costs, particularly in comparing costs for dry and liquid sugar operations on a per unit delivery basis.

FIG. I.– APPROXIMATE LOCALITIES OF THE UNITED STATES SERVED BY LIQUID SUGAR PRODUCERS 1950–51*



* See text for description of how estimates were made.

Location of sources of liquid sugar in the United States

At the time of this study, there were production points or redistribution stations for liquid sugar in New York City, Boston, Philadelphia, Baltimore, New Orleans, St. Louis, Chicago, Indianapolis, Detroit, Toledo, Saginaw, Milwaukee, San Francisco - Oakland Bay area, and Los Angeles. Facilities were under construction at Portland, Oreg., to remelt refined beet sugar to supply liquid sugar users in that locality. This operation also blends liquid sugar with corn sirup at the remelt station, tailor-making blend ratios to suit individual customer demand for these blends.

All imports of liquid sugar in recent years have been taken by refiners in New York City. These imported liquid sugar shipments after further refinement are intermingled with domestically produced liquid sugar and are sold without separate identification. During 1951, imports of liquid sugar were 5.1 percent of the total liquid sugar sold by primary distributors (cane refiners, beet processors, and importers of direct consumption sugar).

Location of a source of supply for liquid sugar is primarily dependent on two factors: It must be (1) in a locality of heavy potential demand for liquid sugar, sufficient to support a producing unit or redistribution station of economic size, and (2) near an economic source of raw material. The supplier of liquid sugar must have for processing into liquid form a source of sugar, which, primarily because of a freight advantage or price difference, enables him to sell liquid sugar on a competitive basis with refined dry sugar available to users in the same locality.

These factors have been the chief contributing causes for the establishment of liquid sugar refineries and redistribution stations in the Midwest cities. The Mississippi River and its tributaries serve as a water route for raw material to St. Louis and Chicago from New Orleans; the Great Lakes - Erie Canal system provides a route to Chicago, Detroit, and Toledo from New York City and other eastern ports, and the eastern beet area supplies raw material to Michigan and Wisconsin for liquid sugar produced in these areas.

Until the advent of liquid sugar, cane-sugar refineries were located at or near deep water ports. The western beet-sugar producers, except for those having factories near the coastal cities, are more interested in competing in the dry sugar market. Possible outlets for liquid sugar are not sufficiently concentrated in the Rocky Mountain area to warrant the installation of liquid-sugar facilities, and on account of the extra processing required for making liquid sugar from beets, their efforts toward achieving marketing economies have been chiefly devoted to development of various methods for distributing dry sugar in bulk lots.

The freight cost for the movement of liquid sugar, based upon total weight of sugar and water, is the principal reason why it is not readily available on a competitive basis with dry sugar in all localities. The present rail freight rate for dry refined sugar applies also to liquid sugar. The water contained in liquid sugar is one-fourth to one-third of the gross weight; and when freight costs for handling this are included in freight charges, price differentials and other cost advantages of liquid sugar are absorbed in a relatively short haul. Any reduction in freight charges for the water content would extend the area in which present producers could competitively sell liquid sugar. The freight rate situation and its effects on liquid-sugar marketing are discussed later in this report.

DISTRIBUTION OF LIQUID SUGAR

Methods of distribution

Liquid sugar is distributed from producers' plants in bulk form in tank trucks and by rail in tank cars. One producer also uses barges for delivery by water to nearby points and a tank ship for shipment to redistribution stations in the Great Lakes area. From these redistribution stations the liquid sugar is reshipped by truck or rail to users. A very small quantity of liquid sugar is shipped in drums, going principally to one-time users and to those who wish to experiment with liquid sugar in their formulas before installing a bulk-handling facility.

Tank trucks generally carry either 1,500-or 3,000-gallon units. The 3,000-gallon lot is carried in a tank trailer, and the smaller unit is handled in a tank mounted on a truck chassis. Larger units up to 4,500 gallons can be carried in tank trailers, but these larger trailers are not very widely used, because of highway weight limit restrictions in many States. Those who market liquid sugar in several States have different maximum loads the weight depending on restrictions in each State. The smaller unit, generally 1,500 gallons, is used only to points close to the producer; it is being replaced by the larger 3,000-gallon unit wherever possible. This is because the costs for delivery of the 1,500-gallon unit, including time of driver and mileage, are very nearly equal to those for the 3,000-gallon unit, or about double the transport costs per hundredweight of sugar delivered. In some metropolitan areas, where narrow streets and small storage tanks prohibit the use of trailer trucks, the 1,500-gallon unit will continue to be used. However, costs for handling liquid sugar in this volume have been such that no producer interviewed desired to expand his distribution by use of vehicles of this size.

Tank cars for handling liquid sugar may have capacities of 8,000 to 12,000 gallons. Their use is restricted to those buyers who have large storage capacities, a high rate of use, and rail sidings at their plants.

In the East, tank cars are made of stainless steel, specially adapted for liquid sugar transport, and some cars have internal heaters to prevent low-temperature crystallization and to facilitate flow of sugar. On the west coast, tank cars of mild steel construction designed for petroleum shipment are in wide use, in addition to the more expensive stainless steel tank types.

In many areas, milk trucks on "return hauls" have been used to advantage. Shipments of milk from producing areas to large metropolitan areas, such as New York City, are frequently handled by tank trucks suitable, after cleaning, for hauling liquid sugar. They have been utilized to supply liquid sugar to users in western Pennsylvania, Ohio, upper New York State, and nearby New England States from New York City. Similar arrangements are being developed in the Midwest and in the Pacific Coast States.

The average hauling distances 9/ were estimated to be 35 miles for trucks, and 265 miles for rail shipments. The range of average distances reported by individual producers was very wide, truck haul averages ranging from 5 to 100 miles and rail haul averages from 15 to 500 miles.

The greatest distance for truck hauls averaged 262 miles, ranging from 60 to 550 miles for all companies; rail shipment maximum distances averaged 535 miles, with a range of 130 to 1,000 miles for all companies. Those companies that hired or used trucks on a "return haul" load basis reported 100 to 200 miles greater distances for these than for company-owned vehicles.

Areas in which liquid sugar is delivered

Distances over which liquid sugar is transported vary for each producer point. Methods of shipment, extent of market development, and size of the area in which users are concentrated are some of the principal factors affecting distribution. Through interviews with producers and with users, areas of distribution were approximated. Figure 1 shows these localities.

Not all points within the shaded portion of the map are serviced by liquid-sugar deliveries. However, in terms of distance and locality, they are within the service zone of one or more liquid sugar suppliers and some sugar customers in each general locality are now being supplied with liquid sugar.

Industrial sugar use statistics 10/ are available for the five regions outlined in figure 1. Potential market estimates, discussed later in this report, are based on these same five regions of the United States.

9/ Estimated by sales managers in each company and expressed in terms of miles weighted by volume of sales.

10/ Published quarterly by Sugar Branch, PMA.

Comparative costs of handling liquid sugar and dry sugar from producer to user

Each producer of liquid sugar was requested to give labor costs for handling liquid sugar, dry sugar in 100-pound bags, and dry sugar in bulk. On the basis of labor costs of loading sugar from a warehouse, a storage tank, or directly from refining processes, and costs of the unloading operation at the consumer receiving point, a measure of the labor efficiency of each method was obtained. Each producer carrying out these operations with his own labor force 11/ described his typical methods and load size for each type of sugar. Assuming the average sugar content of all liquid sugars to be 7.65 pounds per gallon (68.5° Brix), all loads were reduced to a cost per ton of sugar handled. The results were:

For Truck Loading:

	Liquid sugar	100-pound bags	Bulk dry sugar
Labor cost a ton (Cents)	8.3	38.6	13.9

For Truck Unloading:

Labor cost a ton (Cents)	12.4	22.5	14.9

Data were not sufficient to compare rail tank car loading on an industry average basis; however, reports from individual companies show a similar situation exists for rail tank cars.

An additional feature in favor of bulk (both liquid and dry) handling should be noted. These labor costs are a reflection of the loading and unloading time per vehicle and are a saving in "space-time" at crowded loading and unloading docks. Bulk handling increases the efficiency of dock space, as pointed out by several producers.

As a method competitive with bulk handling of liquid sugar, the bulk-dry sugar operation lends itself to many of the savings in the cost of handling liquid sugar. Furthermore, there are no additional pounds of water on which freight must be paid.

Dry sugar in bulk form offers possibilities for increased marketing efficiency and reduced handling costs for users now buying bagged sugar. It is handled in bulk-bin trucks and tank cars, and in large bins that are installed full of sugar and ready for use in the user's plant. It has

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11/ Four producers have contracted for these services and were unable to furnish data on actual labor costs.

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a price differential under dry bagged sugar and can be handled mechanically by blowers or conveyors in the user's plant. From the user standpoint, if a sirup is required in the manufacturing process, dry bulk sugar has many of the disadvantages of dry bagged sugar when compared to liquid sugar. However, for those who can use either wet or dry ingredients and for those who must use dry sugar, dry bulk sugar may reduce costs for ingredients and ingredient handling.

Pricing of liquid sugar

Liquid sugar prices generally follow the price pattern set for 100 pounds of dry refined sugar in a paper bag. The differential for liquid is the net difference between the price for 100 pounds of sugar solids in solution, and the price for a 100-pound bag of dry sugar. Prepaid prices are based on the solids content 12/, but freight charges also include the charges for weight of water. Discounts for cash settlement are generally the same as are allowed for dry sugar.

There are some variations from dry sugar pricing methods that affect the marketing of liquid sugar. In the event of an upward price move, dry sugar frequently may be bought at the old price for delivery during a "grace" period. These deliveries and grace period times are generally limited by warehouse stock conditions at the refinery or consignment points. Only in a few instances have such conditions of sale, following a price increase, been allowed to liquid sugar users.

Different bases for computing prices for partial or total invert liquid sugars are used in different areas. On the east coast, prices are based on the total weight of sucrose and invert 13/ solids contained in the sirup; on the west coast, the price is based on the total dry sucrose equivalent of the sugar solids. The net result, so far as the user's price for sugar is concerned, is the same in most instances.

12/ Solids content is the amount of sugar contained in a unit (by weight) of liquid sugar solution. It is expressed as a percentage of the gross weight of the sugar and water; that is, a 67 percent solids liquid sugar contains 67 parts by weight of sugar and 33 parts by weight of water.

13/ Inversion of sugar (see footnote 6, page 4) adds approximately 5 percent by weight to the sugar solids by the addition of one molecule of water for each molecule of sucrose inverted.

USE OF LIQUID SUGAR

Types of processes that use liquid sugar

Any industrial process that uses sugar dissolved in water as an ingredient is naturally adapted to the use of liquid sugar. In other instances, where sugar is used dry but water is introduced as an ingredient, the adoption of liquid sugar by means of formula adjustment has been found to be practical. The making of cake dough, where dry sugar plus shortening creamed together is used in the standard process, is an example. By mixing liquid sugar, flour, and shortening together, instead of adding flour and water later as was previously done, the creaming was achieved, and the finished product had crust, texture, and crumb characteristics comparable with those of cake made with dry sugar and shortening creamed together.

In dry and semidry products, such as nougat centers, cremes, glace fruits, icings, and crystal coatings, liquid sugar has been used successfully; the extra heating time required to remove excess water is more than offset by other handling shortcuts due to the "flow" method of handling liquid ingredients.

The principal food product categories to which liquid sugar is suited or adaptable are: (1) Beverages, (2) ice cream and dairy products, (3) flavored sirups, extracts, and blended sirups and concentrates for fountain and table use, (4) baked sweet goods, including frosted coatings and icings, (5) confectionery products, and (6) canned, bottled, frozen, and preserved fruits and fruit juices.

Limitations in use of liquid sugar

Liquid sugar is limited in use to those processes in which water is used, or in which the removal of excess water by evaporation does not adversely affect the final product. It is not advantageous in processes in which dry ingredients are normally required. Some examples include the production of baking and ice cream mixes prepared in dry form; production of cookies, crackers, and hard candies, in whose preparation removal of excess moisture would be a detriment; soft fruit processing, where water content is already excessive and any extra heating would break down pulp tissues; and jelly-making, where the boiling time must be kept to a minimum to retain delicate flavor.

In addition to these process limitations, use of liquid sugar is impractical for the smallest industrial users of sugar. Six weeks has been suggested as the maximum "safe" keeping period for sucrose-type

liquid sugars. 14/ If the minimum load of liquid sugar which the producer can deliver is 1,500 gallons, the rate of usage is 300 gallons a week, this would mean a period of 5 weeks for use of one delivery.

Taking into account necessary sanitation precautions, such a user must require at least 2,226 pounds (300 x 7.42) of sugar a week if he is to use sucrose types of liquid sugar in a bulk system. If the minimum load of sugar available to him is 3,000 gallons he must use at least twice this quantity. If he is at such a distance from the supply point that rail shipments are required, his minimum receipt will be 8,000 gallons, requiring a weekly consumption of approximately 12,000 pounds.

The invert liquid sugars have higher densities and their storage life is considerably longer than those of the sucrose types. Maximum-density invert sugar solutions have been kept for several months, or from season to season, by some seasonal fruit processors, without any appreciable change in water content and without contamination from molds or other micro-organisms.

Costs for tank storage, piping, pumps, and other handling equipment are about the same whether the user receives one load a month or one a week. The small user must buy a tank of sufficient size to accommodate at least one load. If his rate of use is low, the annual amortization of investment also will be low, and probably will require a number of years of use before the installation will pay for itself through savings in sugar costs and labor.

From the viewpoint of producers, users should require at least 2,000 bags of sugar a year before considering liquid sugar. For the user who requires sugar for only a 3-month seasonal period, deliveries should be at a rate equivalent to 10,000 bags a year. This higher rate is to make possible amortization of investment in about the same number of years as is possible for the nonseasonal user.

14/ If fans for ventilating the storage tanks are used, evaporation over this period of time may produce crystallization of sugar by increased concentration of sugar in the sirup. If fans are not used, evaporation and condensation drip on the surface of the sirup will sufficiently dilute the surface to allow mold growth. Air-borne spores will provide the contamination source. The use of ultraviolet lights has been found effective in controlling mold contamination on the surface, but their effectiveness is reduced by distance from the light source. As the liquid level is lowered in the tank, the intensity of ultraviolet light is reduced to the point of no effectiveness at the surface of the liquid, although still effective on the air above.

Types of handling facilities for liquid sugar installed by users

Facilities installed, other than number of tanks, in most users' plants follow the same general pattern. Some have innovations installed by the users or with the aid of the suppliers which make the installations more efficient or take advantage of previously installed facilities.

Tanks are of two principal types, mild steel with an inner coating to prevent contact of the sugar solution with the metal, and stainless steel which requires no inner coating. The number of tanks installed varies according to the section of the country. In the East, two or more tanks usually are used, with separate piping to pumps or outlets, for ease in tank cleaning without interruption to the sugar-using processes. In the Midwest and Pacific Coast States the single-flow system, even if multiple tanks are used, is the prevalent type of installation. 15/ The size of tanks used varies widely, but the larger capacities relative to use rate are found in the more recent installations. Experience has shown that tank capacity should be large enough to store sugar for at least 3-days' use in addition to the space required for a minimum load of liquid sugar. For example, if daily use is 500 gallons and the minimum delivery is 3,000 gallons, a capacity of 4,500 gallons is needed. Some users have found that this "rule of thumb" measurement does not give them sufficient leeway for assuring continuous operation, and they

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15/ Two schools of thought, with experience to back up each one, exist on this question: Advocates of a single-flow system maintain that under continuous operation during use periods, the volume of use will be such that contamination could not reach dangerous levels; that bottom filling and draining of storage tanks will keep any surface contamination from entering the system until the tank is completely emptied; and that in cleaning, water is used for flushing lines and tanks which, if not completely dried throughout tanks and lines, would dilute new sirup sufficiently to allow mold growth. For these reasons, they contend a single-flow system is all that is required.

Those who advocate a twin-flow system give consideration to crystal formation on the sides of tanks and in lines if sugar becomes too concentrated through evaporation or lowered temperatures. They advocate that older sirup be completely used before tanks are refilled and that tank and connecting lines be cleaned at that time. If contamination of liquid sugar develops, the problem can be isolated and handled without affecting the entire stock of stored liquid sugar and without interruption to the sugar-using processes.

In the author's opinion, users considering the type of installation to use should consider the experiences of other users nearby, since both climate and selling practices of suppliers have an effect on the decision. However, if the higher density invert liquid sugars are to be used, then the additional expense of twin-flow systems does not appear necessary.

recommended a storage capacity of as much as 7,000 gallons under these same use conditions.

In some areas, a prefabricated 5,000-gallon tank was available and was cheaper than specially ordered in-between sizes. Batteries of these tanks were installed to give the desired capacity. These are connected to a common inlet for incoming sugar. A piping system connects them to a pump for pressured distribution in the plant.

A number of installations surveyed were equipped to handle liquid sugar and corn sirup as well. Users reported satisfactory mixing of the two sirups was achieved by means of separate discharge lines to a single pump which mixed the two in the desired proportions in the pumping process. Proportionate rates of flow for the blended sweetener were controlled by size of piping leading to the pump. In two plants visited, automatic metering devices were used to control the flow rate of the two sirups. Canners on the west coast were the principal users surveyed who have these methods of combining sweeteners. The usual ratio of corn sirup to liquid sugar was one part of corn sirup to three parts of liquid sugar (Parts by weight of solids to give a 3 to 1 ratio of sugar to corn sweetener solids). The corn sirup was generally the "regular" or 43° Baumé and the liquid sugar was of the sucrose type with a Brix of 67°.

Piping used with liquid-sugar installations was of stainless steel in most of the plants visited. Where flow meters were used, these were predominately of the automatic cut-off type which would stop the flow of sirup after a predetermined quantity was delivered. Generally, outlets at points where liquid sugar was used were located above the vats, permitting open flow of sirup. A supplementary valve very near this outlet reduced pipe outlet draining time and made cleaning easier.

Figure 2 shows the relationship between installation costs and annual rates of sugar use of individual users. The broken line represents the approximate functional relationship between cost and rate of sugar use, but, as can be seen from the location of the dots representing users, there are divergencies from any straight-line relation between the two factors. The location and slope of the line, however, indicate that the cost of a facility is not directly proportional to the amount of sugar use, but rather that the larger users have lower costs relative to use than the smaller users.

Among liquid sugar users contacted, there was no functional relationship between quantity of sugar used and in-plant savings per hundredweight of sugar. Figure 3 shows the individual user's experience with in-plant savings related to his annual sugar purchase volume. In both figure 2 and figure 3 some dots represent more than one user since some users had identical experiences with liquid sugar.

FIG. 2.-USER'S LIQUID SUGAR FACILITY COST RELATED TO ANNUAL RATE OF SUGAR USAGE
(55 INDUSTRIAL USERS)

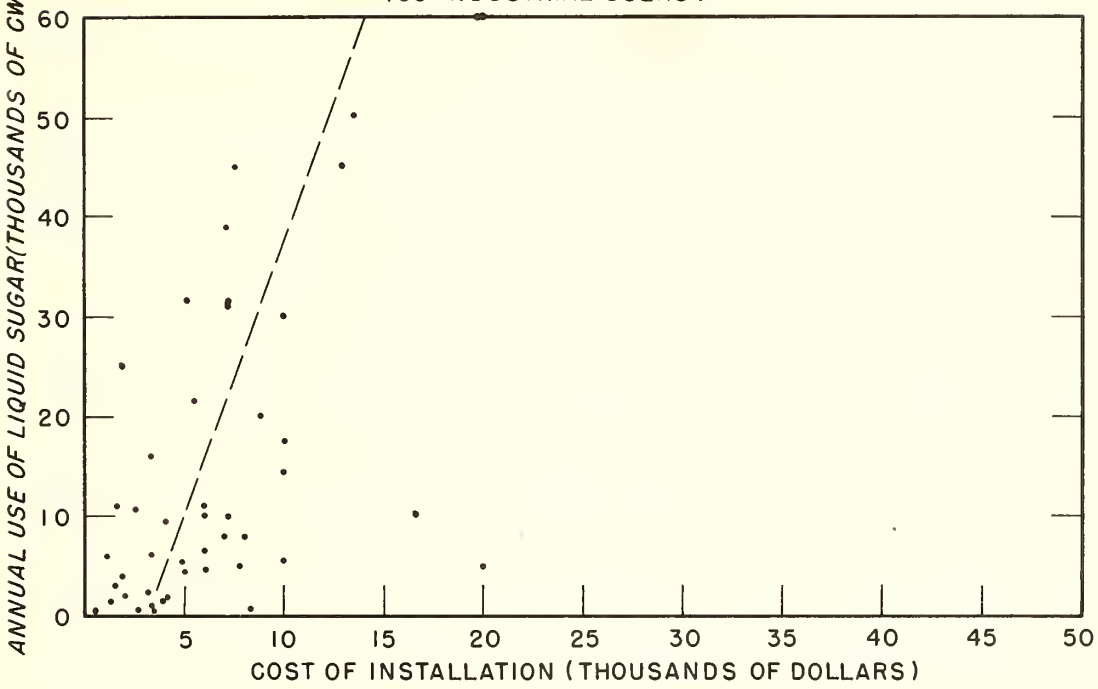
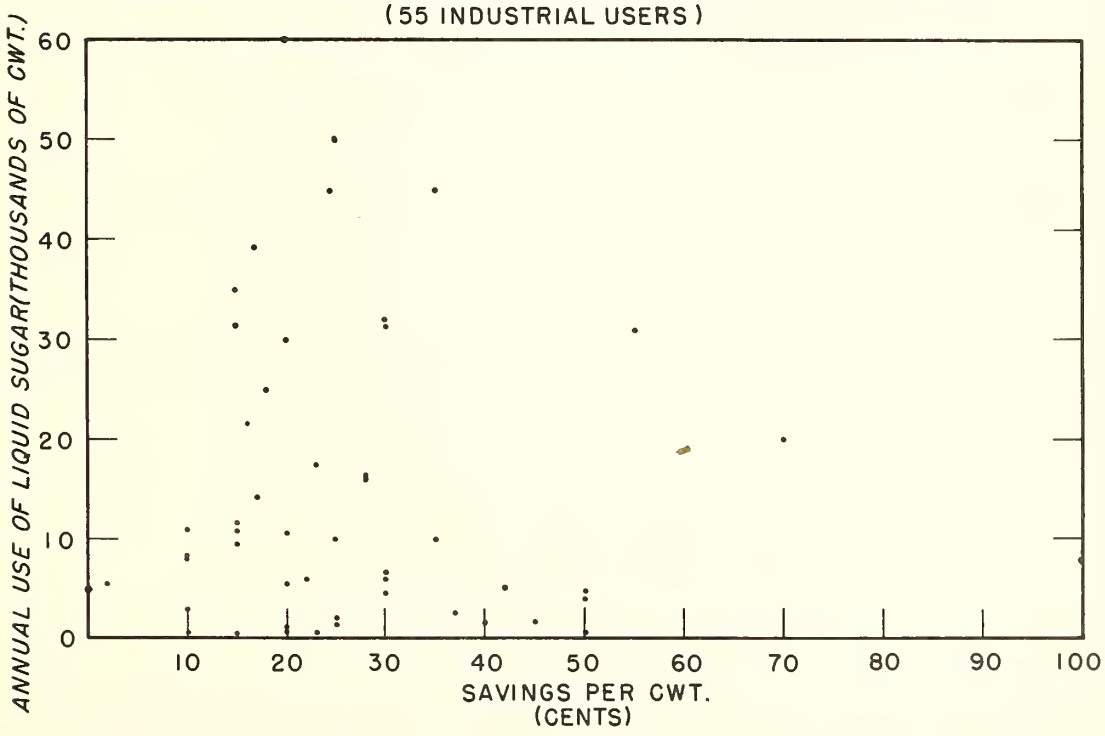


FIG. 3.-IN-PLANT SAVINGS PER CWT. OF LIQUID SUGAR USED
(55 INDUSTRIAL USERS)



Savings realized through the use of liquid sugar in the plant

The change from dry ingredients handled in batch or lot methods, involving multiple handling, to liquid ingredients handled by pipes and meters and (in some instances) under continuous flow process was found to reduce processing costs in most user plants. The amount of saving was found to be highly variable, depending largely on the efficiency of the process before and after changeover.

Forty-one users were able to give figures (either actual or estimated) on the savings realized by using liquid sugar in their processes. 16/ .The average saving was $2.91 a ton of sugar used but the range was very wide - from 18 cents to $16 a ton.

The industrial user who is considering the use of liquid sugar should examine his own process to determine which time and labor requirements would be eliminated or reduced by the introduction of liquid sugar. Among users contacted, the steps in handling most frequently noted as being eliminated were as follows:

(1) Unstacking and moving bag sugar to dumping point.
(2) Dumping bags of sugar.
(3) Melting and filtering sugar sirup.
(4) Bundling and storing empty bags.
(5) Moving sugar sirup to points of use.
(6) Measuring sugar sirup for batches.
(7) Preparing batch lots of sugar sirup from dry sugar.
(8) Cooling sugar sirup before processing.

Also, in only a few instances, these steps were eliminated:

(9) Partial inversion of the sucrose sirup.
(10) Filtration of water before making sirup.

Savings were also noted in the following steps in handling and storing sugar:

(11) Unloading of railway car or truck.
(12) Moving sugar to storage.

In a few instances, there was a saving in:

(13) Dumping bag sugar into bulk bins.

16/ Eleven of those contacted were unable to furnish any data on the saving of liquid sugar over dry sugar because their plants were built to use liquid sugar and they had had no experience with dry sugar.

Those users who were able to eliminate or minimize the most steps realized the greatest savings. In some plants, the installation of liquid-sugar facilities accompanied other plant modernization changes and the benefits gained from the use of liquid sugar were only a part of total savings in production costs.

Other advantages enumerated by users were:

(1) Savings in storage space.
(2) More accurate sugar inventory control.
(3) Elimination of spillage from torn bags and around dumping stations.
(4) Elimination of paper-bag disposal problem.
(5) Convenience of having "stock solution" of sugar on hand at all times - particularly during peak demand periods when the normal sirup-making capacity would have been overworked.
(6) Reduction of the problem of hiring labor, particularly seasonal labor, to handle the large number of bags.
(7) Elimination of wage expense in situations in which a quantity of sirup was required before the day's operation could begin. Extra hours required to make this preparation, and resultant overtime wages, put a premium on the cost of sirup made from dry sugar.
(8) Pilferage from sugar stocks. One user reported a continual problem of sugar pilferage by employees, a practice which had become like a "traditional concession" to workers. Liquid sugar eliminated the problem without employee-management friction.
(9) Reduction of handling problems through ease of combining liquid sugar with other liquid sweeteners or ingredients. Some users who desired to add corn sirup to their formulas were reluctant to do so until liquid sugar was available to simplify the handling problem.
(10) Flow processing, particularly for liquid final products, which was made possible by constant flow ingredients, proportioned to formula by varied pipe sizes, flow rates, and pressure feeding. Having available prepared liquid sugar of constant analysis made possible this further improvement of product processing.
(11) Convenience. This factor was mentioned by a majority of users, and usually meant a combination of one or more of the advantages already named.

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Disadvantages or complaints from users of liquid sugar

The potential liquid sugar user should give thought to some of the disadvantages other users have found or considered probable with the change to liquid sugar:

(1) In a multiple-product process, such as making confectionery and bakery items, not all items are suited to the use of liquid sugar as the sweetening ingredient. Also, for some items, the extra heating to remove any excess water breaks down the structure of soft fruits or destroys delicate flavors.

When dry sugar is a "must" for one part of production, liquid sugar may create confusion among workers, particularly if they are prejudiced toward change in their work conditions: the handling of more than one sweetener type thus may increase rather than reduce operating costs.

(2) Changeover to liquid sugar may tie the user to one source of sugar supply. With dry sugar, there are at least several sources of supply in any area of the United States. With a liquid sugar installation, the user may have only one source of supply - and although no cases of actual supply restriction or "squeeze" were reported, several users indicated that they gave this question consideration before making the change. In several cases, an emergency stock of dry sugar and the facilities for handling were retained after the change to liquid sugar was made, in the event that a curtailment of liquid sugar supply should occur.

(3) In some areas of the Midwest, where liquid sugar is made by the ion-exchange process, a user who requires a pure sucrose type of sweetener is unable to use this liquid sugar which contains from 2 to 5 percent of inverted sugar as a minimum.

(4) Ability to increase inventory in the event of a price rise, is reduced. Purchasers of dry sugar are given a grace period following a price rise in which they can buy sugar at the previous price. This privilege is not always given to the buyer of liquid sugar. His opportunity to buy at the lower price is limited to the storage capacity of his tanks.

(5) Discount prices for liquid sugar below prices for dry refined sugar are not a "sure thing" in the future. A number of users pointed out that they put in their installations when the discount was 20 or 25 cents a hundredweight under dry refined cane sugar. This discount has been reduced in recent years to 15 cents and later in many instances to 10 cents. The reduction in discount has increased the amortization period for the liquid-sugar installation.

(6) Delivery sometimes is made at nours inconvenient to the user. A few instances of sugar delivery at night or in the early morning before the plant was open were reported.

(7) Determination of quality and quantity requires a more elaborate laboratory procedure than is required for dry sugar. Generally these factors are left to the producer, with only an occasional check by the user. Users pointed out that they felt they could see quality better in dry sugar, and they could always count the bags to ascertain the quantity received.

(8) Spoilage worries were less when dry sugar was used, and if some spoilage did occur, the entire stock seldom was affected. None of the users interviewed reported having a spoilage or contamination problem, but several indicated they were more concerned with this possibility than when they bought dry sugar.

(9) Leakage, spilling, and spoilage problems occur with liquid sugar, although users interviewed said the situation with liquid use is an improvement over that with dry sugar. Chief difficulties reported were leakage of the sirup at pipe joints, particularly at points where machinery vibrations or temperature variations loosened the joints. Temporary or movable couplings, such as those used when liquid sugar is delivered from trucks or railway cars to storage tanks or at points of use, also present a leakage problem. This was reported as particularly troublesome when bees or other insects could get to the leakage point. Unless a thorough clean-up was made of any spilled sugar, as well as that clinging to outlet caps, insects came in large numbers.

The disadvantages discussed are less significant than their number may indicate. Comments of users on these disadvantages were from scattered points throughout the survey area, and in most cases the complaint or problem was found with only one user. Comments of users generally reflected confidence and satisfaction with present arrangements, and their comments on the efforts of producers to eliminate virtually every cause of complaint indicate that this factor has helped to generate the feeling of good will.

Competitive selling of liquid sugar in a dry sugar market has caused producers to make concessions or give additional services with liquid sugar. Even in areas where liquid sugar production has resulted from the demands of user groups, extras have been given. All consumers contacted made reference to assistance, advice, or services received from producers concerning their purchase and use of liquid sugar.

Some of these concessions by producers are:

(1) Assistance in the financing of users' installations to the extent of allowing the user to repay the cost of an installation over an extended period, with small-payments based on use of sugar.
(2) Provision of engineering assistance in the determination of the proper physical installation to be made. In some cases, this assistance has gone beyond the tank, storage, and pump requirements. Some users have been assisted in planning more efficient use of space in the processing plant and use of handling facilities for the other ingredients used with sugar.
(3) Cooperation with users in sweetener problems, particularly in formulation of invert sugar ratios and elimination of contamination sources.
(4) Extra services, such as cleaning of tanks for seasonal users, delivery service at odd hours and on short notice, guarantee against bacterial contamination of liquid sugar in consumer tanks, and quality-control testing of finished products.
(5) In some instances, arrangements by which liquid sugar users with a short seasonal use have been able to contract for liquid sugar during this period at a price advantage.

These advantages for liquid sugar users have not been available to the same extent to all users, nor is there any indication as to whether they will be continued indefinitely. For this reason, consideration is not given to the advantages listed above when savings through the use of liquid sugar are discussed in this report.

All sellers of liquid sugar have made various price concessions to users. These are generally in terms of a price differential under the price for 100 pounds of dry refined cane sugar, or the standard refined sugar price. This differential has varied at different points and times from a maximum of 45 cents a hundredweight in the mid-1930's to the average of 15 cents a hundredweight for white sucrose liquid types in 1951. This differential has been further decreased (since the survey of producers) to a level of 10 cents a hundredweight in most areas.

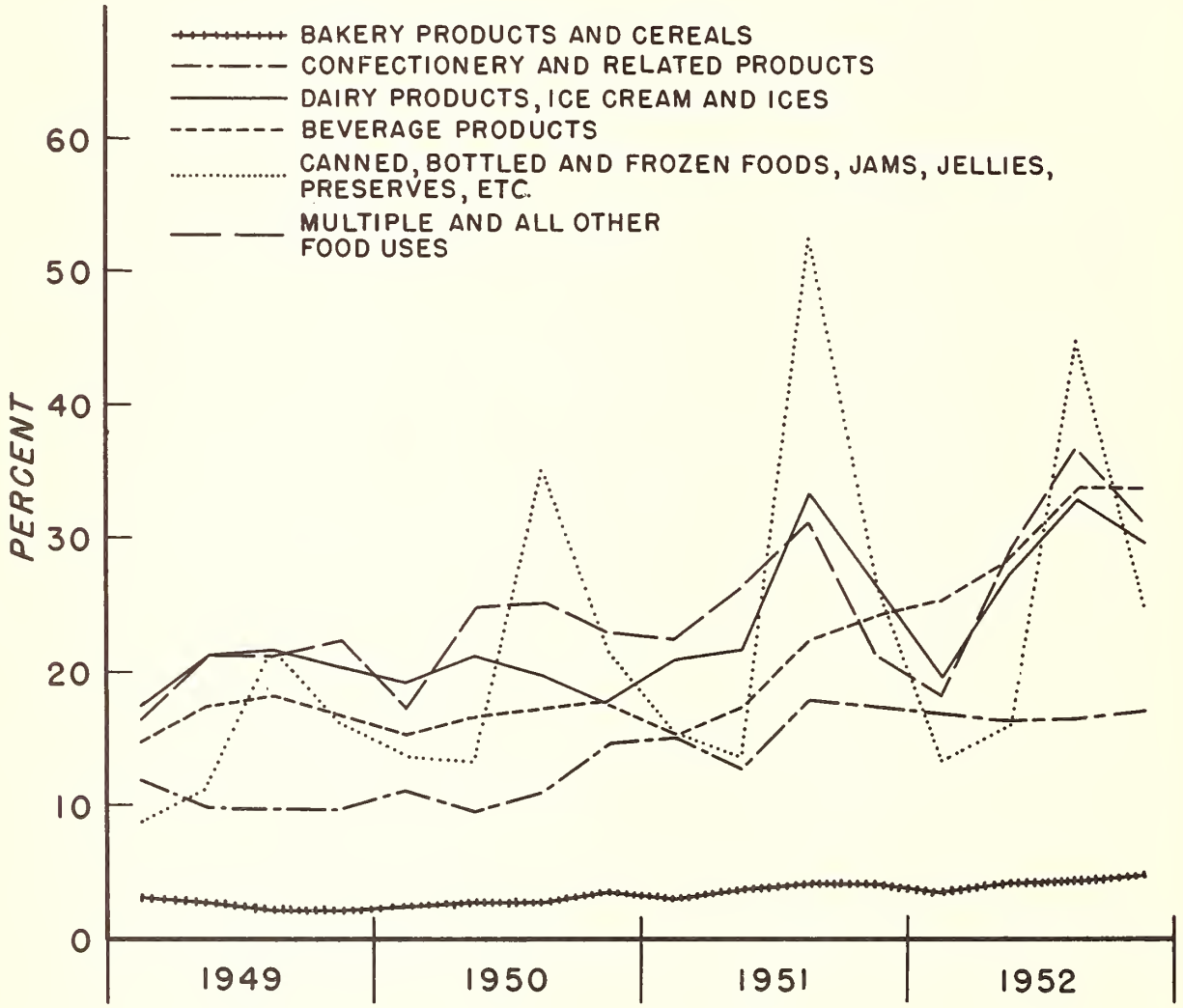
The most widespread comment of users was with regard to the price differential for liquid sugar. The narrowing of the differential margin has caused concern among users. They are wondering whether they are facing a price rise to the level of dry refined cane sugar, now that they have installed liquid facilities and must depend on sugar in this form for an extended period to realize a return above costs for their installations.

Table 2.--Distribution of sugar by primary distributors to industrial users, 1949-52 1/

Year and type of sugar	Bakery products & cereals	Confectionery products	Dairy products, ice cream & ices	Beverage products	Canned, frozen, preserved foods	Multiple and all other food uses	Non-food products
1949							
Total sugar - - - - - 1000 cwt.2/	12,116	12,791	4,446	14,265	8,857	4,015	737
Liquid sugar - - - - 1000 cwt.2/	323	1,304	904	2,417	1,451	828	31
Percent liquid sugar is of total - - - - - Percent	2.7	10.2	20.3	16.9	16.4	20.6	4.2
1950							
Total sugar - - - - - 1000 cwt.2/	12,724	13,919	5,074	15,047	11,010	4,993	780
Liquid sugar - - - - 1000 cwt.2/	364	1,606	993	2,508	2,738	1,151	55
Percent liquid sugar is of total - - - - - Percent	2.9	11.5	19.6	16.7	24.9	23.1	7.0
1951							
Total sugar - - - - - 1000 cwt.2/	12,444	12,450	5,140	14,404	11,165	4,926	794
Liquid sugar - - - - 1000 cwt.2/	439	1,922	1,287	2,797	3,428	1,239	53
Percent liquid sugar is of total - - - - - Percent	3.5	15.4	25.0	19.4	30.7	25.2	6.6
1952							
Total sugar - - - - - 1000 cwt.2/	13,617	12,933	5,541	15,365	10,956	5,230	915
Liquid sugar - - - - 1000 cwt.2/	578	2,160	1,506	4,636	3,195	1,502	57
Percent liquid sugar is of total - - - - - Percent	4.2	16.7	27.2	30.2	29.2	28.7	6.2

1/ Figures represent approximately 96 percent of total sugar distribution.
2/ Quantities expressed as 1000 hundredweight of solids.

FIG. 4 - PERCENTAGE OF LIQUID SUGAR IN TOTAL SUGAR SOLD BY PRIMARY DISTRIBUTORS TO EACH OF 6 GROUPS OF INDUSTRIAL USERS, 1949-52



Growth in distribution of liquid sugar

Although commercial distribution of liquid sugar had its beginning in the late 1920's, the largest increase in use has occurred since 1948. During that period it has increased from 5.9 percent to 9.5 percent of all sugar distributed by primary distributors in the United States. Direct distribution to industrial users 17/ has increased from 12.9 percent in 1949 to 21.4 percent in 1952. Data on distribution by type of buyer have been collected since 1948 and are presented in table 6. 18/ Table 2 presents an annual summary of sugar sales by primary distributors according to kinds of industrial users, for the years 1949 through 1952.

Liquid sugar's growth in use is also reflected in figure 4 which shows primary distributors' quarterly sales to users of liquid sugar as a percentage of the total sugar sold to each type of industrial user. Canned, frozen and preserved foods show the largest gains of any group and figure 4 also reflects the large third-quarter sales of sugar to this industrial user group on the west coast.

Seasonal delivery patterns for liquid sugar, as reflected by the graph, denote differences in sugar purchase practices between dry and liquid-sugar users. Forward purchases of liquid sugar for seasonal use, because of storage limitations as to time and volume, are not as great and do not follow the same "time of purchase" pattern as dry sugar. There are also indications that the larger, strictly-seasonal sugar users (canners on the west coast, for example) have converted their processes to liquid sugar to a greater extent than nonseasonal sugar users. Greater percentage variations occur for seasonal distribution of liquid sugar than for dry sugar. The most obvious instance shown occurred between the second and third quarters of 1951 on distribution to the canned, bottled, and frozen food products. An increase from 439,000 to 2,175,000 hundredweights for liquid sugar occurred with an increase from 3,193,000 to 4,141,000 hundredweights of all sugar. The quantity of liquid sugar distributed to this industrial user category was increased 395.7 percent while all sugar volume increased 29.6 percent.

17/ A small quantity of liquid sugar goes to institutional users, wholesale grocers, jobbers and sugar dealers from primary distributors, and eventually goes into industrial-type use. This small quantity is omitted from the calculation of total industrial sugar purchases.

18/ Sugar Deliveries by Type of Product or Business of Buyer published quarterly by the Sugar Branch, PMA, U. S. Department of Agriculture.

THE FREIGHT RATE FOR LIQUID SUGAR AND ITS EFFECT ON DISTRIBUTION AND USE

The freight rate for liquid sugar

The principal deterrent to nationwide distribution of liquid sugar is the freight charge. On an equivalent sweetener basis, freight rates for liquid sugar are one and one-third to one and one-half times the rates for dry sugar. Rail freight rates for liquid sugar are determined at the dry sugar rate for the total weight, including the weight of the water solvent. For the sucrose-type liquid sugar, 100 pounds of sugar solids are combined with approximately 50 pounds of water and the total freight charge is one and one-half times the freight rate for 100 pounds of dry sugar. For invert types having approximately 75 percent solids, 100 pounds of sugar solids are combined with approximately 33-1/3 pounds of water, and the freight rate is one and one-third times that for dry sugar. Motor carrier and barge rates are determined on a similar basis.

This freight rate disadvantage is compensated to some extent by (1) the liquid sugar differential in price under dry bagged sugar and (2) the in-plant savings realized by the user through the use of liquid sugar. Also, it should be noted that liquid sugar is not available from all dry-sugar basing-point sources. Its freight costs to some points where dry sugar is available from a nearer basing point are prohibitive to its use.

The industrial user contemplating the use of liquid sugar should consider these freight cost differences and the savings he can make in his own operations (the average savings of users contacted in the survey for this report was $2.91 a ton of sugar, but varied from 18 cents to $16). Thus he can ascertain whether an advantage would be gained by a change to liquid-sugar use.

The potential user of liquid sugar can easily determine the difference in cost, including freight, between dry and liquid sugar.

The following method can be used in obtaining a cost figure for any point and for any source of liquid sugar and dry sugar:

(1) Determine delivered price for dry bagged sugar. This is the f.o.b. price at the refinery plus freight charges.
(2) Determine the delivered price for liquid sugar. This is the f.o.b. price per hundredweight of solids plus the freight cost. (The freight cost is equal to the dry sugar freight cost from the liquid-sugar production point divided by the percent of solids in the liquid sugar.)

(3) Estimate the savings per hundredweight of sugar used which will be realized by the shift from dry to liquid sugar, and subtract this amount from the total delivered price (the amount obtained in step 2).
(4) The difference between cost obtained in step (1) and the cost obtained in steps (2) and (3) is the amount of savings or increased cost for each hundredweight of sugar used that may be expected with the change to liquid sugar.

In a theoretical example, suppose these conditions were found:

	F.o.b. price Dollars	Freight rate Dollars	Solids Percent	Estimated in-plant saving Dollars
Dry sugar (100 pounds)	8.00	0.40	100	0.00
Liquid sugar (100 pounds)	7.90	.40	72	.10

in equation form:

$$(\$8.00 \neq .40) - (\$7.90 \neq \frac{.40}{.72} - .10) = \neq \$0.05 \text{ a hundredweight}$$

In this case, a user who wished to use a partial invert sugar containing 72 percent solids would be realizing a net saving, based on differential plus in-plant savings, of 5 cents a hundredweight.

If the potential user of liquid sugar is located where a more favorable sugar rate for liquid sugar than the prevailing rate for dry sugar is obtainable, such a rate should be substituted for the dry sugar rate. The example that follows is an illustration of the computation when the freight rate for dry bagged sugar is different from the liquid sugar freight rate.

	F.o.b. price Dollars	Freight rate Dollars	Solids Percent	Estimated in-plant saving Dollars
Dry sugar (100 pounds)	8.00	0.40	100	0.00
Liquid sugar (100 pounds)	7.90	.38	66.5	.10

the saving would be:

$$(\$8.00 \neq .40) - (\$7.90 \neq \frac{.38}{.665} - .10) = 0.03 \text{ a hundredweight}$$

Figure 5 shows the principal areas in which the dry-sugar freight basing point is a source of liquid sugar (Boston, New York City, Philadelphia, Baltimore, New Orleans, and San Francisco). Industrial users in

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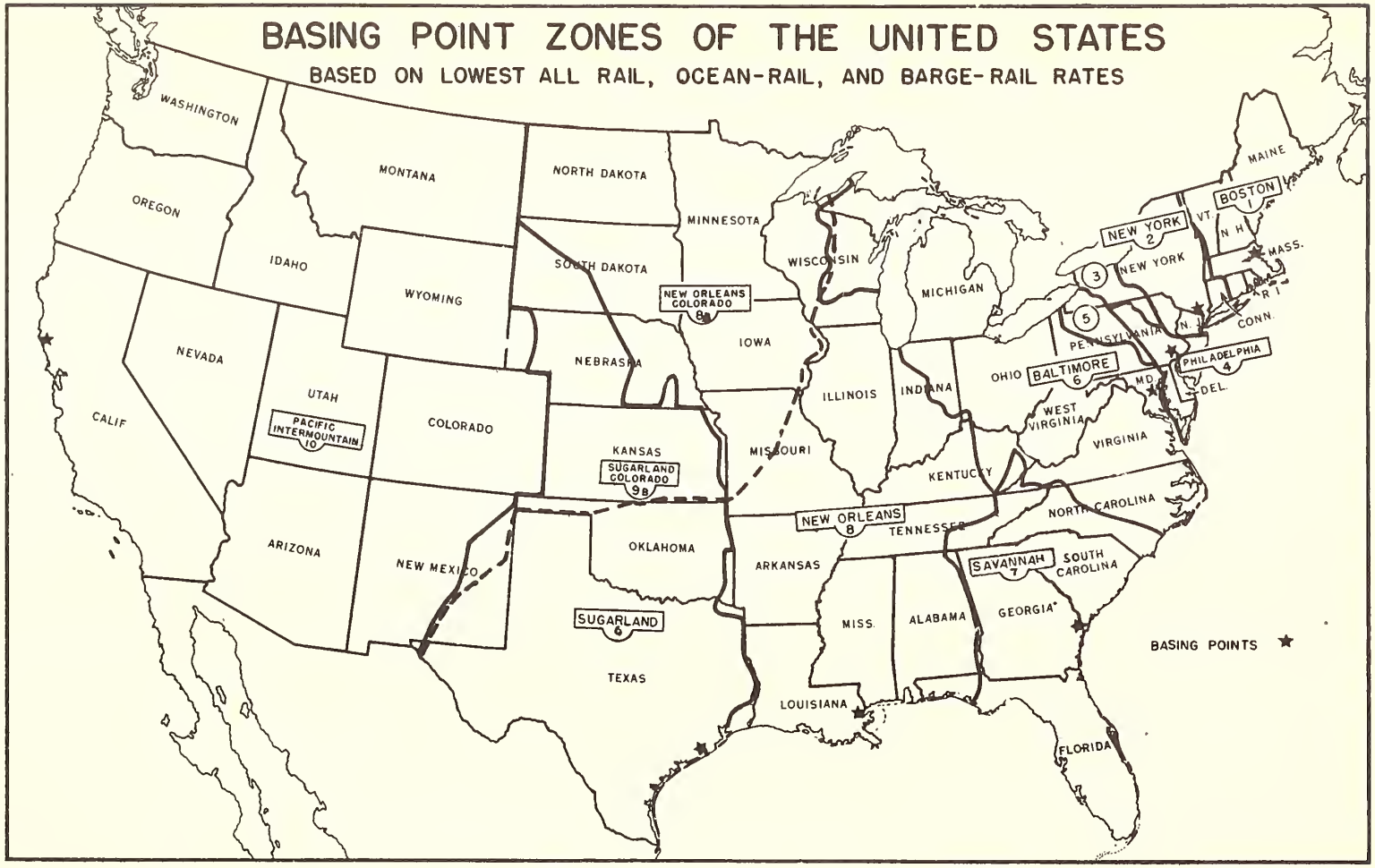

Figure 5.- The map describes the basing zones as computed from rates in effect as of about May 6,1948. Some over-all percentage increases have been granted since that time but in effect the general picture remains essentially the same. In the map, zone 3 is served equally freightwise by New York and Philadelphia. Likewise, zone 5 is served equally by Philadelphia and Baltimore. The broken line cutting zones 8 and 9 represents the points where freight costs from the Colorado beet district are just about equal to the prevailing seaboard cane refinery prepays. Zone 10 describes the territory based freightwise on San Francisco. Actual selling and distributing territories of the refiners, of course, often are quite different from the basing point zones.
Source: American Sugar Refining Company.

in these basing point zones can estimate their costs for liquid sugar on the basis of dry-sugar freight rates from these base price points.

As an example of this determination, a user at Buffalo, N. Y., would have a rail freight charge for dry sugar of 45.1 cents a bag in carload lots of 400 bags. To "break even" on liquid sugar of 66.5 percent solids at this freight cost, he must have a combined in-plant saving and price differential of approximately 22.6 cents a hundredweight of solids used. On a per ton basis, this amounts to $4.52 and is 39 cents less than the average saving of users contacted in the survey.

Producers reported that the major volume of liquid sugar is distributed from the production point or redistribution station by tank truck. For distribution in most metropolitan areas, trucks are owned and operated by the company. On the longer hauls to outlying areas, the trucks are generally leased to the sugar producer, or are trucks, such as milk trucks, making return hauls. These were reported to be more of a convenience to the user in terms of time and size of load, and somewhat lower in cost than rail freight shipments, but they were not available to all areas adjacent to the production sources.

Possible solutions to the freight rate problem for the distribution of liquid sugar

The most obvious solution to the problem of freight rates for liquid sugar would be a lowering of the freight rate to the point where the water content is not considered in the freight cost calculation, so that the freight rate for liquid sugar would apply to the weight of the solids only. This would mean a reduction of one-fourth to one-third of the present freight rate for liquid sugar. Any reduction in freight rate for liquid sugar which reduces the freight charge for the water solvent will have the effect of expanding the area of distribution from present production sources.

Use of lower-rate water transportation for raw sugar going to liquid-sugar refineries near point of use and for shipments of liquid sugar to redistribution points offers possibilities for increased area distribution of liquid sugar in competition with dry sugar. Midwestern refineries and redistribution stations now in operation use this principle.

POTENTIAL MARKET FOR LIQUID SUGAR

Determination of the potential market for liquid sugar

The economics of present distribution and use of liquid sugar, as discussed in previous sections, set certain limitations upon volume

of the potential market 19/. Limitations as to size and type of user, competition with dry sugar, freight cost disadvantages coupled with the fact that industrial users are widely scattered in some regions will prevent under present marketing conditions, the expansion of liquid-sugar use into every section or community and application where it could be used.

A measure of the potential market for liquid sugar, taking into account the first two limiting factors; (1) volume of annual sugar use and (2) type of product, is possible by using 1947 Census of Manufactures data. These data 20/ were collected in 1947 from each industrial user of sugar, and were suitable for a sort by type of final product and by volume of sugar use. A special sort of the census data was made, excluding those industry classes whose processes or final products were unsuited to liquid sugar. The volume of sugar use, by type of industrial user was divided at three levels; (1) total sugar use, (2) use by all establishments requiring more than 400,000 pounds a year, and (3) use by all establishments requiring 200,000 to 400,000 pounds of sugar a year. These data were broken down by category of use, by United States, regional, and State totals wherever possible. 21/ A summary, by regions, of these data is given in table 3. Each establishment represents a single plant at one physical location and it may be one of several owned by one company. Thus, in terms of sugar use, each establishment would have a purchase volume equal to the limitation set for the group to which it belongs.

Present and potential markets for liquid sugar in the five regions

The five regions, so selected to coincide with regions used in tabulation of sugar use statistics by the Sugar Branch, are the New England, Middle Atlantic, North Central, Southern and Western regions. The geographic breakdown by States is shown in figure 1.

19/ The potential market for liquid sugar in industrial use includes all users, regardless of location or size, whose processes and products are adaptable to a liquid sweetener. However, to give a more realistic determination of the potential market, the limitations which apply to current use were applied in the determination of the potential market discussed in this report.

20/ See table 7 in the Appendix for statistics on sugar use as prepared by the Bureau of the Census.

21/ When less than three establishments fell into a category or group, their volume of purchases was omitted, since their inclusion would have revealed individual company operations. In those States having very scattered users, several State totals were included in a single tabulation to permit use of statistics from as many categories as possible. This doubling up was done principally in the South Atlantic, Eastern Gulf, Middle Western, and Rocky Mountain States.

Table 3.--Potential market for liquid sugar for United States, by regions, in 1947 and extent of development in 1951

Kind of sugar distributed and used		New England	Middle Atlantic	Southern	North Central	Western	United States 1/
Total industrial sugar used by selected industries 2/	1,000 lb.	366,623	1,571,403	1,112,386	1,777,900	781,670	5,625,701
Total sugar consumed by users of 200,000 to 400,000 lb. a year 2/	1,000 lb.	22,667	67,649	127,273	118,420	59,254	401,776
Establishments 2/	number	86	249	461	430	210	1,436
Total sugar consumed by users of more than 400,000 lb. a year 2/	1,000 lb.	237,792	1,367,950	778,065	1,369,002	625,061	4,491,225
Establishments 2/	number	141	502	484	658	341	2,126
Total liquid sugar distributed in 1951 3/	1,000 lb.	116,325	538,474	31,529	135,340	309,288	1,130,956
Potential market for liquid sugar among users of over 200,000 lb. a year	1,000 lb.	260,459	1,435,590	905,338	1,487,422	684,315	4,893,001
Liquid sugar distribution in 1951 as a percentage of 1947 market potential for users of:							
over 400,000 lb. a year	percent	48.91	39.36	4.05	9.88	49.48	25.18
over 200,000 lb. a year	percent	44.66	37.51	3.48	9.09	45.19	23.16
Total consumption by users of less than 200,000 lb. a year	1,000 lb.	106,164	135,813	207,048	290,478	97,355	732,700

1/ United States totals are greater than the sum of the five regional totals. Some omissions from regional totals to avoid disclosure of individual firms' operations cause this difference in total volume.

2/ From unpublished data 1947 Census of Manufactures (An establishment is a plant at one physical location).

3/ Sugar Branch, PMA.

Table 3 shows the relationship between total sugar use; use by establishments requiring more than 400,000 pounds annually, and use by establishments requiring from 200,000 to 400,000 pounds annually during 1947; and the total liquid sugar distributed in these five regions during 1951. Computations of the potential market are in terms of the percentage of liquid sugar to total sugar being sold in each of these regions. No attempt has been made to adjust 1947 census data to 1951 levels of use, as such adjustments could possibly result in a greater error than direct comparison between the different years.

Three regions -- New England, Middle Atlantic and Western -- have already achieved 40 percent to 50 percent of the total potential market for liquid sugar. The North Central and Southern regions are less than 10 percent developed. These two regions, although containing 48.9 percent of the total potential liquid-sugar market, also offer the greatest obstacles to increased liquid-sugar distribution. Except in cities adjacent to the Great Lakes and along the Mississippi River, liquid sugar has not been introduced into most of these regions. Chief obstacles to increased distribution outside of areas now being developed are: (1) The potential market does not appear to be sufficiently concentrated to warrant establishment of new refining sources; (2) competition of dry refined sugar from all sources (beet, mainland cane, and offshore cane) is keenest in the North Central region (In order for liquid sugar to compete in this market, a more advantageous source of raw material for making it must be available); (3) the interior waterways system of the Mississippi River and its tributaries is a relatively slow means of freight movement and, until improved, probably will not serve as a suitable means of distributing liquid sugar any great distance to redistribution stations.

In the North Central and Southern regions there were 2,053 establishments using in excess of 2,000 bags of sugar a year in 1947. In 1951, the equivalent of 1,665,690 bags was distributed as liquid sugar to these regions. Using the average annual rate of 10,000 bags, as reported by users surveyed, as a basis for determining the total number of users, there were, in 1951, approximately 166 out of 2,053 possible users buying liquid sugar. This leaves a total of 1,887 potential users not now buying liquid sugar. Using this same method of determination for the other regions, there are 163 potential users not yet buying liquid sugar in New England, 451 in the Middle Atlantic and 284 in the Western region.

Possibilities for development of full market potential in each region

In the Western region, particularly in California, past development of liquid-sugar use has put the major emphasis on the canning industry. Comments by producers and users indicate that a very high percentage (estimated by one producer to be 90 percent) of the total sugar consumption

of the canning industry in the Pacific Coast States is now using liquid sugar. Although the canning industry occupies the dominant position (an estimated 52 percent of the total potential market for liquid sugar in this region), the other potential users, particularly industries producing blended sirup and flavoring extracts, soft drinks and ice cream, offer possibilities for advantageous development.

Further development of the New England and Middle Atlantic regions' potential market will depend, if the survey of users is a proper indication of over-all marketing activity, on development of small users (2,000 to 4,000 bags) in the localities adjacent to production points, and on conversion of plants, and making liquid sugar available in metropolitan areas other than cities which are liquid-sugar production sources.

The Southern region appears to offer less opportunity for potential market development than any other region. Industrial users are more scattered, perhaps with the exception of those in the Delaware, Maryland, and Virginia area bordering Chesapeake Bay, and in the New Orleans, La., area. The North Central region offers the largest undeveloped potential market. The economic forces opposing development to its full potential were discussed earlier. Present producers of liquid sugar in the region have used three means to meet the competition of dry sugar: (1) Use of beet sugar grown in the Eastern Beet area, (2) use of barge movement of raw sugar via the Mississippi River and its tributaries, and (3) use of redistribution stations that handle liquid sugar made on the east coast and moved by lake tanker to storage tanks in cities on the Great Lakes.

Several possible ways in which the use of liquid sugar may be expanded in the North Central region were considered from the standpoint of present economic application. The experiences of users and producers surveyed indicate that greater distribution and use may be attained by:

(1) Expansion of present facilities already located in the region. Potential market determinations for each location indicate that present distribution of liquid sugar can be expanded within the area now being served.

(2) Establishment of new redistribution stations at other points along the water transport routes, either along the lake route from eastern refineries or along the Mississippi River and its tributaries.

(3) Establishment of beet-sugar remelt stations, particularly in cities in the western part of the region nearest to the western sugar-beet growing area.

(4) Handling of liquid sugar in blends with corn sirup, by the corn sirup industry in the region. This would be a reversal of the procedure now carried on by some of the liquid-sugar producers, wherein

corn sirup is mixed with their liquid sugar to suit the demand for such blends.

Potential market for different types of liquid sugar

Two characteristics, color and inversion ratio, affect the use of various types of liquid sugar in food products. As pointed out in the section on commercially marketed types, both invert and sucrose-type liquid sugars are marketed as colorless or slightly colored sirups. Not all regions have these types available, but in the eastern United States, where liquid sugar has been in use for the longest period, a market for each type has been developed. Where the colorless and colored sirups are available, the colored sirups are sold at a price differential under the colorless types. In 1951, the differences generally amounted to 10 cents a hundredweight of solids.

Where a choice of color and inversion ratio is available to the user, the type of final product will be one of the governing factors influencing the choice of type to use. In general, users who select a sucrose type will do so to avoid the hygroscopic characteristics of invert sugars. Makers of hard candies, crystal coatings, and similar products, where the absorption of atmospheric moisture can be a detriment in the final product, will avoid invert sugars. Also, to a slight extent, food freezers whose freezing and storing equipment is not adaptable to lower freezing points will avoid this effect of invert sugar.

In terms of color, those whose concern is protection of a delicate flavor or a high degree of whiteness in the final product will be interested only in the colorless liquid sugars. Light amber or darker hues are acceptable in making dark-colored products with strong flavor characteristics. Also in products flavored with mild molasses, caramel, or honey, as well as in those containing many of the colored fruits, the slight color and minor flavor effects of the colored liquid sugars appear to present no problem.

The use of some invert sugar can be tolerated in most food products made with liquid sugar. Some products also depend on inversion of sugar to produce desirable characteristics in the final product, crust-browning and raising of dough in bakery items, moisture retention for "chewiness" of candies, and increased shelf-life freshness for packaged items, for example.

Relative volumes of sucrose and invert types distributed were estimated by each producer contacted in the survey. These percentage estimates were used to calculate the approximate quantity of each type of liquid sugar available from all producers. Of the total 11,309,561 bags distributed in 1951, approximately 69.8 percent was sucrose and ion-exchange low-invert types containing less than 5 percent of inverted sugars; 24.7 percent was medium invert type containing from 5 percent to

Table 4.--Potential market for liquid sugar by category of use

(hundredweights of solids, as purchased)

Industrial category	1947 Census of Manufactures			1951	Liquid sugar percentage of total sugar consumed by users requiring more than:	
	Total use	By establishments using more than: 400,000 lb. yearly	200,000 lb. yearly	Liquid sugar distribution by primary distributors	400,000 lbs. a year Col.4 ÷ Col.2	200,000 lbs. a year Col.4 ÷ Col. 3
	(1)	(2)	(3)	(4)	(5)	(6)
	Cwt.	Cwt.	Cwt.	Cwt.	Percent	Percent
Bakery products	11,390,960	3,363,590	9,550,950	438,594	5.24	4.59
Confectionery and related products	13,993,590	12,852,750	13,195,970	1,922,324	14.96	14.57
Dairy products - ice cream and ices	5,856,570	4,292,040	4,911,240	1,286,567	29.98	26.20
Beverages and miscellaneous food preparations 1/	14,926,780	10,527,280	11,915,720	2,796,865	26.57	23.47
Canning, preserving and freezing food products	10,089,110	8,876,770	9,362,430	3,428,219	38.62	36.62
Multiple and all other food products 2/	-	-	-	1,239,287		

1/ Miscellaneous food preparations are principally flavored extracts and fountain sirups. No separate category is given for blended sirup for table use and is included primarily in the multiple and all other food products group.
2/ This category does not occur in the 1947 Census of Manufactures. The liquid sugar use for this category is included in the groups named above.

Source: 1947 Census of Manufactures. Special tabulations of sugar use by industrial users
Sugar Branch PMA - Quarterly report of Primary Distributors, Distribution by Sugar by Type of Buyer.

50 percent of inverted sugars; and 5.5 percent was high invert type containing more than 50 percent of inverted sugars.

Interviews with users of liquid sugar indicated that the high ratio of use for sucrose types was chiefly because of the availability of this type, and unfamiliarity with invert and colored types and with possible effects they might have on their product.

Invert and colored liquid sugars offer possibilities for expanded use with present transportation rates and production sources for liquid sugar. Invert types have a higher solubility in water than sucrose types when the percent of invert sugar is in range of 20 percent to 60 percent of the total sugars. These medium invert liquid-sugar types are generally 75 percent by weight of solids. This greater percentage of solids in invert mixtures is an advantage from the freight cost standpoint. Nine pounds more solids (sugars) are in each 100 pounds of gross weight. This is an increase of approximately 13 percent in the quantity of sugar which can be transported for the same cost as 67 pounds of solids in sucrose-type liquid sugars.

For processors whose products are suited, from the standpoint of flavor, or other characteristics to a less refined sweetener, the colored liquid sugars may be substituted to a slight advantage. These types have a price differential, generally 10 cents a hundredweight of solids 22/, under colorless liquid sugars. These factors make the use of invert and colored liquid sugars advantageous in those fringe areas where freight charges make the cost of colorless sucrose-type liquid sugar slightly higher than dry bagged sugar. Distribution of colored and invert types of liquid into fringe areas is now being done on a small scale in the eastern United States.

Table 4 presents potential market quantities of sugar by category of industrial use, compared with the distribution of liquid sugar to each category. Figure 6 presents these statistics in a bar chart showing percentage of development to 1951 of the total estimated potential. Dairy products and the canning, preserving, and freezing of food products show the largest percentage development. The marketing of invert and colored liquid sugars to users in each of these product categories appears to offer possibilities for expanding use from present liquid-sugar production points.

An example of a potential market for these liquid sugar types is provided by four industrial user categories -- dairy products, soft drinks,

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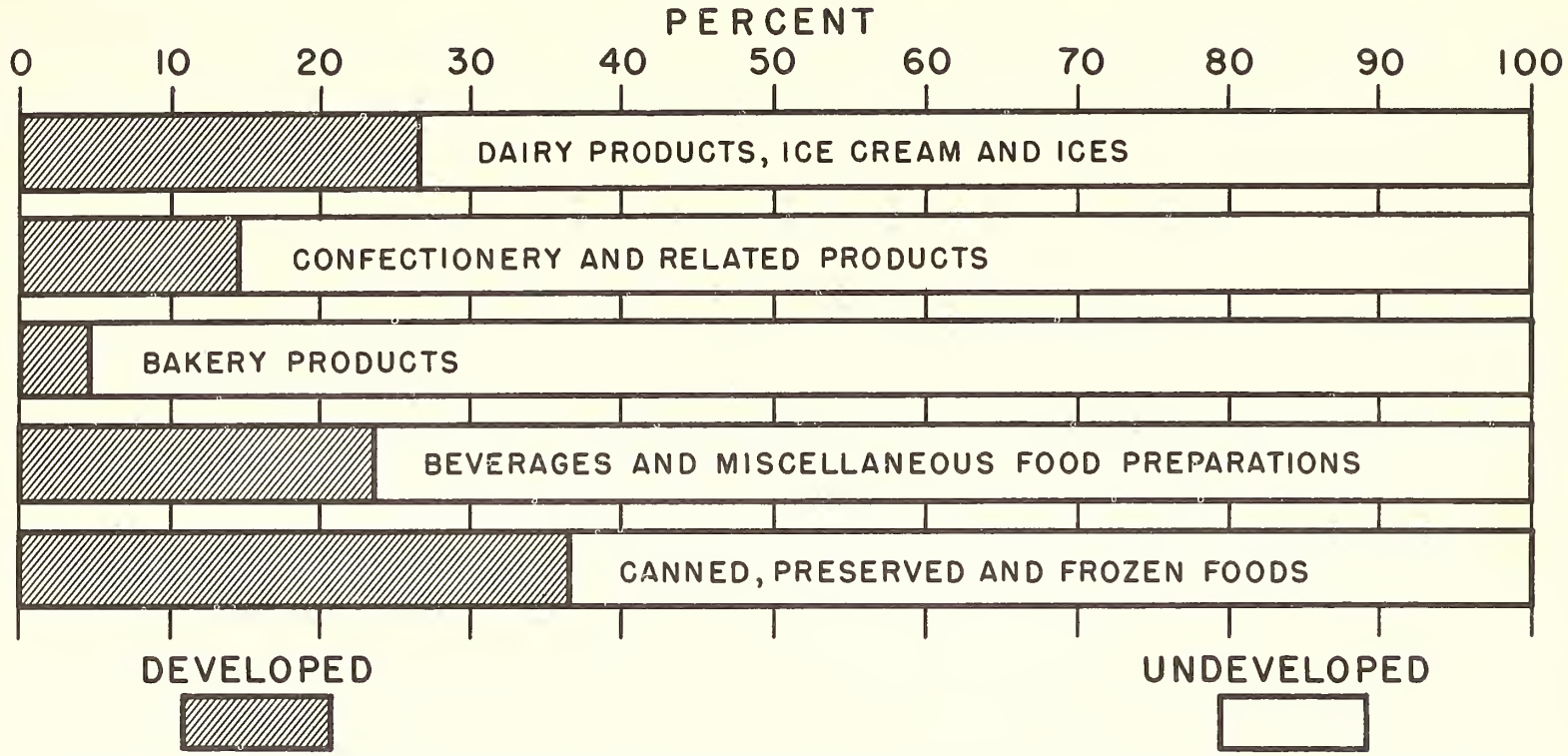
22/ This differential varies, depending on the degree of refinement or color removal. The total solids contained in the solution, determined by Brix measure, is the basis for pricing liquid sugars, therefore, the difference in price between colorless and colored liquid sugars is not wholly a difference in price for sugar.

FIG. 6.- PERCENTAGE OF DEVELOPED AND UNDEVELOPED MARKET FOR LIQUID SUGAR, BY TYPE OF PRODUCT USED, 1951



EACH BAR REPRESENTS 100 PERCENT OF TOTAL SUGAR CONSUMED BY FIRMS USING MORE THAN 200,000 POUNDS OF SUGAR A YEAR.

SOURCE: 1947 CENSUS OF MANUFACTURES (SPECIAL TABULATION)
SUGAR REPORTS: QUARTERLY DISTRIBUTION OF SUGAR BY PRIMARY DISTRIBUTORS—SUGAR BRANCH, PMA

blended sirups and flavoring extracts, and food canning, preserving, and freezing -- in the fringe area including Maryland, Delaware, District of Columbia, Virginia, and West Virginia. These user categories require approximately 852,000 bags of sugar a year for 76 users each of which buys 4,000 or more bags a year. On the basis of interviews with liquid-sugar users in these categories of use, an estimated 75 percent of this quantity could be sold as invert-sucrose blends of liquid sugar, and approximately 50 percent of this latter quantity could be of the colored types.

In 1951, approximately 315,000 bags were distributed as liquid sugar into this area. On the basis of the determinations above, a market for 639,000 bags of invert-sucrose blend liquid sugar existed. Of this quantity, 319,000 bags could be marketed as the less refined colored sirup.

The maximum and average freight rates by truck, rail, and water for dry sugar from the nearest basing point to those Southern States are as follows:

State	Highest base rate Cents a cwt.	Average rate, all points Cents a cwt.
Maryland	48	21.1
Delaware	24	18.8
Virginia	68	33.3
West Virginia	68	44.3

The freight rate for sugar going into the District of Columbia from the nearest basing point is 16 cents a hundredweight.

CONCLUSION

The economic position of liquid versus dry sugar in the industrial user market

Continued need for increased efficiency and reduced marketing costs, from raw material to consumer, and the competitive forces that bring these improvements about will cause further expansion of liquid-sugar marketing in the United States. Competition for a market by sugar producers and the search for lower material and processing costs by users are the dominant forces that will push this expansion. Bulk handling methods, for both liquid and dry sugars, have shown significant increases in use in the last decade. In the industrial user market, the potential use level for liquid sugar, by present standards of balance between advantageous and disadvantageous application, has not exceeded 50 percent of the potential market, except in a few metropolitan areas. Any development that alters the balance of advantage will necessarily increase or decrease this potential market. Two major

factors, (1) the freight charge for water in liquid sugar and (2) the differential between bulk (dry or liquid) and bagged sugar, if altered, will shift the advantage position.

A continued increase in liquid sugar availability in the North Central region, with both enlarged refining sources and more re-distribution stations in areas of heavy industrial demand, is indicated. Competition with bulk dry sugar, from beets and cane, will be keenest in this region and it is expected that the expansion, whether to liquid or dry bulk, will depend on which enters the individual market area first. Since investment in either liquid or dry bulk handling systems requires several years for amortization, a user converted to one method will be slow to change to another.

Actions that will aid expansion of liquid sugar use

In addition to the aforementioned adjustments of freight rates and liquid-sugar price differentials to more favorable levels, the following actions also will influence the expansion of liquid-sugar use:

(1) Education of users. Several producers pointed out that some user demand for extra clear "water white" liquid sugar is not necessary, particularly when such sugar is used in dark-colored and strongly flavored products. Less refined and less decolorized liquid sugar would be equally suitable and can be sold at a lower price. Education of users with regard to types of liquid sugar and the appropriate uses of each should broaden the market for invert and colored types, and result in savings to the user and a reduction in marketing costs through higher sugar-to-water ratios in the liquid sugar.

(2) Improved marketing practices and promotional activity. Sales practices such as describing a competitor's liquid sugar as being inferior, likely to clog lines, or cause other problems in processing promote distrust among users and cause undue criticism of liquid sugar. Brand and producer source preference, where more than one source was available, was not apparent among users. Several users, however, said such selling practices occur from time to time and they believed that these practices hurt over-all liquid sugar sales expansion.

(3) Further research into liquid sugar production and use. Development of grades and standards for liquid sugars along the lines of application and use is needed. Standardization can help to reduce the number of variable qualities and characteristics now found among different types. It can also reduce the necessity for individual experimentation where a grade has been developed and is used by members of the industry making the same type of end product.

Other lines of research will further increase the potential market for liquid sugar. These might be devoted to contamination sources and their control to prolong the storage life of liquid sugar, toward elimination of colloid-type precipitates occurring in beverages, and toward development of sirup blends, particularly of liquid sugar and corn sirup, for specific application. Many of these lines of research are already under way.

In short, any action that increases the area of distribution or the number of applicable uses for liquid sugar will broaden its market among industrial sugar users. As the shift in the sugar distribution pattern from home use to industrial use continues, the need for reduced marketing and handling costs also will increase to offset possible declines in the producer's share of the ultimate sugar consumer's dollar.

Table 5.--Domestic cane- and beet-sugar distribution, by primary distributors, and liquid-sugar imports, United States 1935-52 1/

Year	Distribution by refiners			Distribution by beet processors	Distribution by importers of crystalline sugar	Distribution by mainland-cane sugar producers	Distribution by importers of liquid sugar	Total distribution and imports
	Refined crystalline	Liquid	Raw					
	Short tons, raw value							
1935	4,444,429		10,183	1,478,660	614,628	86,028	49,758	6,683,686
1936	4,453,878		11,032	1,364,847	719,138	157,300	69,560	6,775,755
1937	4,640,636		13,946	1,245,498	615,432	155,890	38,733	6,710,135
1938	4,529,417		10,480	1,448,865	562,652	91,839	38,783	6,682,036
1939	4,336,618		6,176	1,810,456	572,807	141,461	42,146	6,909,664
1940	4,540,582		7,779	1,551,518	693,917	96,872	38,633	6,929,301
1941	5,253,848	193,917	8,573	1,952,597	564,044	96,478	39,140	8,108,597
1942	3,132,335	153,442	5,587	1,648,377	451,609	74,854	2/ 3,481	2/ 5,469,685
1943	3,966,315	205,144	15,196	1,508,618	494,101	123,817	2/ 58,771	2/ 6,371,962
1944	5,026,122	267,830	9,875	1,155,624	522,931	164,968	2/ 65,494	2/ 7,212,814
1945	4,170,028	265,897	5,021	1,042,283	458,533	98,244	-	6,040,006
1946	3,366,854	245,431	3,939	1,376,045	480,150	148,289	-	5,620,708
1947	4,945,434	288,521	9,025	1,545,066	532,866	115,922	-	7,447,834
1948	4,705,236	369,281	2,343	1,656,663	511,693	97,755	18,106	7,361,077
1949	5,067,399	374,587	2,212	1,486,889	514,430	134,708	32,476	7,612,701
1950	5,383,851	485,027	2,636	1,748,701	553,988	105,127	39,939	8,319,269
1951	4,867,043	528,593	1,864	1,730,180	490,824	118,069	30,887	7,767,460
1952 3/	5,201,646	628,191	2,843	1,559,524	583,458	123,793	39,869	8,139,324

1/ Published sugar distribution figures less exports plus imports of liquid sugar. Include deliveries for use by U. S. Expeditionary Forces and exclude deliveries for liberated areas, lend-lease, and military relief. 1935-40 All exports subtracted from refiners' refined crystalline. 1941-49 export figures, available by type of primary distributor, subtracted from refined crystalline figures for each category.

2/ Includes an estimated quantity of liquid sugar imported as flavored and colored sirups from Mexico and Cuba.

3/ Preliminary.

Table 6.—Liquid sugar distribution as a percentage of total sugar distribution by type of product or business of buyer, quarterly 1949-52[1/]

1949

Type of product or business of buyer		First quarter	Second quarter	Third quarter	Fourth quarter	Calendar year
Bakery and allied products; cereals and cereal products	Liquid sugar - - - -Cwt.	88,015	86,292	76,812	71,555	322,674
	Total sugar - - - - Cwt.	2,929,017	3,093,639	3,391,843	2,701,956	12,116,453
	Liquid pct.of total-Pct.	3.0	2.8	2.3	2.6	2.7
Confectionery and related products	Liquid sugar- - - - Cwt.	342,427	284,791	325,759	350,986	1,303,963
	Total sugar - - - - Cwt.	2,892,863	2,864,107	3,337,497	3,696,658	12,791,125
	Liquid pct.of total-Pct.	11.8	9.9	9.7	9.5	10.2
Ice cream and dairy products	Liquid sugar- - - - Cwt.	153,160	307,143	306,551	137,159	904,013
	Total sugar- - - - Cwt.	883,678	1,464,315	1,416,184	681,642	4,445,819
	Liquid pct.of total-Pct.	17.3	21.0	21.6	20.1	20.3
Beverages	Liquid sugar - - - -Cwt.	429,739	748,763	800,170	438,516	2,417,188
	Total sugar- - - - -Cwt.	2,900,970	4,292,707	4,410,403	2,660,561	14,264,641
	Liquid pct.of total-Pct.	14.8	17.4	18.1	16.5	16.9
Canned, bottled, frozen food; jams, jellies,preserves	Liquid sugar- - - - Cwt.	121,974	200,380	862,377	266,367	1,451,098
	Total sugar - - - - Cwt.	1,419,763	1,795,318	3,986,635	1,655,364	8,857,080
	Liquid pct.of total-Pct.	8.6	11.2	21.6	16.1	16.4
Multiple and all other food uses	Liquid sugar- - - - Cwt.	164,172	212,541	258,520	192,519	827,752
	Total sugar- - - - -Cwt.	948,333	999,008	1,207,418	860,404	4,015,163
	Liquid pct.of total-Pct.	16.2	21.3	21.4	22.4	20.6
Non-food products	Liquid sugar- - - - Cwt.	6,390	6,731	9,914	8,101	31,136
	Total sugar - - - - Cwt.	204,148	150,778	221,408	161,089	737,423
	Liquid pct.of total-Pct.	3.1	4.5	4.5	5.0	4.2
Hotels,restaurants and institutions	Liquid sugar- - - - Cwt.	308	882	126	108	1,424
	Total sugar - - - - Cwt.	140,386	139,421	124,176	142,675	546,658
	Liquid pct.of total-Pct.	0.2	0.6	0.1	0.1	0.3
Wholesale grocers, jobbers, sugar dealers	Liquid sugar- - - - Cwt.	17,410	31,365	39,139	31,563	119,477
	Total sugar - - - - Cwt.	11,964,816	13,496,370	17,812,294	10,531,208	53,804,688
	Liquid pct.of total-Pct.	0.1	0.2	0.2	0.3	0.2
Retail grocers chain stores super markets	Liquid sugar - - - Cwt.	-	25	4	3,184	3,213
	Total sugar - - - - Cwt.	5,075,408	6,140,796	7,519,426	4,974,388	23,710,018
	Liquid pct.of total-Pct.	-	-	-	0.6	-
All other-including Government Agencies	Liquid sugar - - - Cwt.	690	529	794	700	2,713
	Total sugar - - - - Cwt.	608,230	408,804	324,413	297,106	1,638,553
	Liquid pct.of total-Pct.	0.1	0.1	0.2	0.2	0.2
Total	Liquid sugar- - - - Cwt.	1,324,285	1,879,442	2,680,166	1,500,758	7,384,651
	Total sugar- - - - Cwt.	29,967,612	34,845,261	43,751,697	28,363,051	136,927,621
	Liquid pct.of total-Pct.	4.4	2.5	6.1	5.3	5.4
	Liquid sugar pct. of total industrial sugar use - - - - -Pct.	10.9	12.8	14.9	12.1	12.9

1/ Figures represent approximately 96 percent of total sugar distribution.

Table 6.--Liquid sugar distribution as a percentage of total sugar distribution by type of product or business of buyer, quarterly 1949-52 1/- Continued

1950

Type of product or business of buyer		First quarter	Second quarter	Third quarter	Fourth quarter	Calendar year
Bakery and allied products; cereals and cereal products	Liquid sugar - - - -Cwt.	77,333	94,060	95,388	97,084	363,865
	Total sugar - - - - Cwt.	2,937,834	3,380,291	3,561,836	2,843,858	12,723,819
	Liquid pct.of total-Pct.	2.6	2.9	2.7	3.4	2.9
Confectionery and related products	Liquid sugar- - - - Cwt.	319,520	315,602	458,235	512,355	1,605,712
	Total sugar - - - - Cwt.	2,880,462	3,312,379	4,187,869	3,538,549	13,919,259
	Liquid pct.of total-Pct.	11.1	9.5	10.9	14.5	11.5
Ice cream and dairy products	Liquid sugar- - - - Cwt.	162,132	318,096	318,383	194,302	992,913
	Total sugar- - - - Cwt.	853,233	1,521,948	1,603,680	1,095,142	5,074,003
	Liquid pct.of total-Pct.	19.0	20.9	19.9	17.7	19.6
Beverages	Liquid sugar - - - Cwt.	447,391	713,427	814,228	533,321	2,508,367
	Total augar- - - - -Cwt.	2,946,996	4,320,800	4,761,957	3,016,749	15,046,502
	Liquid pct.of total-Pct.	15.2	16.5	17.1	17.7	16.7
Canned, bottled, frozen food; jams, jellies,preserves	Liquid sugar- - - - Cwt.	198,991	307,314	1,749,163	482,734	2,738,202
	Total sugar - - - - Cwt.	1,450,738	2,335,559	4,993,240	2,230,189	11,009,726
	Liquid pct.of total-Pct.	13.7	13.2	35.0	21.6	24.9
Multiple and all other food uses	Liquid sugar- - - - Cwt.	158,213	325,721	404,922	262,200	1,151,056
	Total sugar- - - - -Cwt.	925,299	1,314,232	1,613,651	1,140,101	4,993,283
	Liquid pct.of total-Pct.	17.1	24.8	25.1	23.0	23.1
Non-food products	Liquid sugar- - - - Cwt.	13,573	10,621	15,990	14,678	54,862
	Total sugar - - - - Cwt.	197,196	131,697	320,720	130,406	780,019
	Liquid pct.of total-Pct.	6.9	8.1	5.0	11.3	7.0
Hotels, restauranta and institutions	Liquid sugar- - - - Cwt.	-	1,232	322	417	1,971
	Total sugar - - - - Cwt.	126,506	137,622	158,170	131,753	554,051
	Liquid pct.of total-Pct.	-	0.9	0.2	0.3	0.4
Wholesale grocers, jobbers, sugar dealers	Liquid sugar- - - - Cwt.	21,680	27,898	51,290	28,338	129,206
	Total sugar - - - - Cwt.	11,561,328	16,617,720	21,512,012	11,084,297	60,775,357
	Liquid pct.of total-Pct.	0.2	0.2	0.2	0.3	0.2
Retail grocers chain stores super markets	Liquid sugar - - - -Cwt.	1,028	2,685	2,627	941	7,281
	Total sugar - - - -Cwt.	5,071,135	5,944,482	7,990,065	4,435,093	23,440,775
	Liquid pct.of total-Pct.	0.2	0.5	0.3	-	-
All other-including Government Agencies	Liquid sugar - - - -Cwt.	48	45	560	12	665
	Total sugar - - - - Cwt.	425,582	293,841	489,465	549,859	1,758,747
	Liquid pct.of total-Pct.	-	-	0.1	-	-
Total	Liquid sugar- - - - Cwt.	1,399,909	2,116,701	3,911,108	2,126,382	9,554,100
	Total sugar- - - - Cwt.	29,376,309	39,310,571	51,192,665	30,195,996	150,075,541
	Liquid pct.of total-Pct.	4.8	5.4	7.6	7.0	6.4
	Liquid sugar pct. of total industrial sugar - - - - - - Pct.	11.5	13.0	18.6	15.1	15.0

1/ Figures represent approximately 96 percent of total sugar distribution.

Table 6.--Liquid sugar distribution as a percentage of total sugar distribution by type of product or business of buyer, quarterly 1949-52 1/-continued

1951

Type of product or business of buyer		First quarter	Second quarter	Third quarter	Fourth quarter	Calendar year
Bakery and allied products, cereals and cereal products	Liquid sugar - - - -Cwt.	85,229	127,961	102,846	122,558	438,594
	Total sugar - - - - Cwt.	3,091,352	3,734,770	2,490,560	3,127,767	12,444,449
	Liquid pct.of total-Pct.	2.8	3.4	4.1	4.0	3.5
Confectionery and related products	Liquid sugar- - - - Cwt.	487,824	448,255	452,794	533,451	1,922,324
	Totel sugar - - - - Cwt.	3,263,195	3,539,201	2,533,069	3,114,594	12,450,059
	Liquid pct.of total-Pct.	14.9	12.7	17.9	17.1	15.4
Ice cream and dairy products	Liquid sugar- - - - Cwt.	225,851	406,323	410,094	244,299	1,286,567
	Total sugar- - - - -Cwt.	1,083,935	1,893,715	1,228,644	934,086	5,140,380
	Liquid pct.of total-Pct.	20.8	21.5	33.4	26.2	25.0
Beverages	Liquid sugar - - - -Cwt.	465,857	826,219	857,260	647,529	2,796,865
	Total sugar- - - - -Cwt.	3,059,927	4,780,797	3,868,219	2,695,430	14,404,373
	Liquid pct.of total-Pct.	15.2	17.3	22.2	24.0	19.4
Canned,bottled, frozen food;jams, jellies,preserves	Liquid sugar- - - - Cwt.	259,303	438,695	2,174,887	555,334	3,428,219
	Total sugar- - - - -Cwt.	1,721,507	3,193,403	4,140,739	2,109,626	11,165,275
	Liquid pct.of total-Pct.	15.1	13.7	52.5	26.3	30.7
Multiple and all other food uses	Liquid sugar- - - - Cwt.	259,358	358,832	357,086	264,011	1,239,287
	Total sugar- - - - -Cwt.	1,153,369	1,372,197	1,149,584	1,250,408	4,925,558
	Liquid pct.of total-Pct.	22.5	26.2	31.1	21.1	25.2
Non-food products	Liquid sugar- - - - Cwt.	19,179	12,643	9,062	11,907	52,791
	Total sugar - - - - Cwt.	244,583	217,050	182,450	149,776	793,859
	Liquid pct.of total-Pct.	7.8	5.8	5.0	8.0	6.6
Hotels,restaurants and institutions	Liquid sugar- - - - Cwt.	1,085	1,267	1,192	1,058	4,602
	Total sugar - - - - Cwt.	142,237	142,241	110,804	180,247	575,529
	Liquid pct.of total-Pct.	0.8	0.9	1.1	0.6	0.8
holesale grocers Jobbers, sugar dealers	Liquid sugar- - - - Cwt.	28,249	20,011	23,929	56,143	128,332
	Total sugar - - - - Cwt.	11,916,080	17,936,488	11,913,101	12,451,833	54,217,502
	Liquid pct.of total-Pct.	0.2	0.1	0.2	0.5	0.2
Retail grocers chain stores super markets	Liquid sugar - - - -Cwt.	3,390	2,804	699	4,000	10,893
	Total sugar - - - - Cwt.	4,803,725	5,964,795	4,873,991	4,872,466	20,514,977
	Liquid pct.of total-Pct.	0.1	-	-	0.8	-
All other-including Government Agencies	Liquid sugar - - - -Cwt.	-	-	1,087	-	1,087
	Total sugar- - - - -Cwt.	462,230	656,928	547,973	580,077	2,247,208
	Liquid pct.of total-Pct.	-	-	0.2	-	-
Total	Liquid sugar - - - -Cwt.	1,835,325	2,643,010	4,390,936	2,440,290	11,309,561
	Total sugar- - - - -Cwt.	30,942,140	43,431,585	33,039,134	31,466,310	138,879,169
	Liquid pct.of total-Pct.	5.9	6.1	13.3	7.8	8.1
	Liquid sugar pct. of total industrial sugar- - - - - -Pct.	13.5	14.1	28.2	18.2	18.4

1/ Figures represent approximately 96 percent of total sugar distribution.

Table 6.--Liquid sugar distribution as a percentage of total sugar distribution by type of product or business of buyer, quarterly 1949-52 1/--Continued

1952

Type of product or business of buyer		First quarter	Second quarter	Third quarter	Fourth quarter	Calendar year
Bakery and allied products; cereals and cereal products	Liquid sugar - - - Cwt.	138,920	141,673	135,858	161,893	578,344
	Total sugar - - - Cwt.	3,500,699	3,439,434	3,331,707	3,344,892	13,616,732
	Liquid pct.of total-Pct.	4.0	4.1	4.1	4.8	4.2
Confectionery and related products	Liquid sugar- - - - Cwt.	552,903	496,266	523,921	587,124	2,160,214
	Total sugar - - - - Cwt.	3,280,809	3,028,875	3,177,029	3,446,431	12,933,144
	Liquid pct.of total-Pct.	16.9	16.4	16.5	17.0	16.7
Ice cream and dairy products	Liquid sugar- - - - Cwt.	268,077	453,434	509,696	274,775	1,505,982
	Total sugar - - - - Cwt.	1,384,227	1,665,487	1,563,438	927,864	5,541,016
	Liquid pct.of total-Pct.	19.4	27.2	32.6	29.6	27.2
Beverages	Liquid sugar - - - Cwt.	813,414	1,343,167	1,475,766	1,003,714	4,636,061
	Total sugar - - - - Cwt.	3,199,203	4,781,854	4,397,429	2,986,623	15,365,109
	Liquid pct.of total-Pct.	25.4	28.1	33.6	33.6	30.2
Canned, bottled, frozen food; jams, jellies,preserves	Liquid sugar - - - Cwt.	242,317	394,818	2,025,471	532,201	3,194,807
	Total sugar - - - Cwt.	1,806,048	2,462,969	4,548,137	2,139,175	10,956,329
	Liquid pct.of total-Pct.	13.4	16.0	44.5	24.9	29.2
Multiple and all other food uses	Liquid sugar - - - Cwt.	242,568	383,722	474,814	401,070	1,502,174
	Total sugar - - - - Cwt.	1,331,963	1,315,094	1,295,394	1,287,382	5,229,833
	Liquid pct.of total-Pct.	18.2	29.2	36.7	31.2	28.7
Non-food products	Liquid sugar - - - Cwt.	17,931	12,344	12,035	14,529	56,839
	Total sugar - - - - Cwt.	248,159	232,747	238,267	196,300	915,473
	Liquid pct.of total-Pct.	7.2	5.3	5.1	7.4	6.2
Hotels,restaurants and institutions	Liquid sugar - - - Cwt.	1,296	981	793	1,670	4,740
	Total sugar - - - Cwt.	141,141	134,680	115,432	129,544	520,797
	Liquid pct.of total-Pct.	0.9	0.7	0.7	1.3	0.9
Wholesale grocers, jobbers, sugar dealers	Liquid sugar - - - Cwt.	25,883	38,264	42,586	37,844	144,577
	Total sugar - - - - Cwt.	14,755,089	14,735,311	15,499,474	12,016,505	57,006,379
	Liquid pct.of total-Pct.	0.2	0.3	0.3	0.3	0.3
Retail grocers chain stores super markets	Liquid sugar - - - Cwt.	5,161	9,355	11,262	8,426	34,204
	Total sugar - - - - Cwt.	5,201,413	5,501,051	5,853,283	4,905,005	21,460,752
	Liquid pct.of total-Pct.	0.1	0.2	0.2	0.2	0.2
All other-including Government Agencies	Liquid sugar - - - Cwt.	-	110	1,241	2,234	3,585
	Total sugar - - - - Cwt.	604,636	725,119	660,392	660,344	2,650,491
	Liquid pct.of total-Pct.	-	-	0.2	0.3	0.1
Total	Liquid sugar- - - - Cwt.	2,308,470	3,274,134	5,213,443	3,025,480	13,821,527
	Total sugar - - - - Cwt.	35,453,387	38,022,621	40,679,982	32,040,065	146,196,055
	Liquid pct.of total-Pct.	6.5	8.6	12.8	9.4	9.5
	Liquid sugar pct.of total industrial sugar use- - - - - Pct.	15.6	19.3	28.5	21.1	21.4

1/ Figures represent approximately 96 percent of total sugar distribution.

APPENDIX

The section that follows presents a special tabulation by the Bureau of the Census from the 1947 Census of Manufactures.

260935

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947

UNITED STATES

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	405	112,272	466	610,353	900,575
Biscuits, crackers, and pretzels	23	6,464	104	226,006	238,521
Confectionery and related products:					
Confectionery products	120	33,740	288	833,954	946,231
Chocolate and cocoa products	2	1/	27	336,116	336,711
Chewing gum	1	1/	18	115,187	116,417
Dairy products:					
Concentrated milk	29	9,542	84	201,940	229,838
Ice cream	160	45,417	134	133,684	242,090
Special dairy products	5	1,424	7	11,855	22,197
Plastic cream and bulk products	20	5,537	64	81,725	91,532
Beverages:					
Soft drinks	468	129,466	426	381,309	800,787
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	32	9,378	87	671,419	691,891
Canning, preserving, and freezing:					
Canning and preserving, except fish	113	32,524	321	733,675	813,406
Pickles and sauces	32	9,047	78	134,814	155,829
Frozen foods	26	6,995	22	19,188	39,676

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

NEW ENGLAND REGION

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	31	8,437	35	43,876	67,005
Biscuits, crackers, and pretzels	--	--	6	8,220	8,271
Confectionery and related products:					
Confectionery products	7	2,210	21	105,938	126,276
Chocolate and cocoa products	--	--	3	1/	35,159
Chewing gum	--	--	2	1/	5,033
Dairy products:					
Concentrated milk	2	1/	4	3,803	5,054
Ice cream	8	2,272	13	9,241	14,984
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	1	1/	4	4,091	4,589
Beverages:					
Soft drinks	29	7,894	29	24,149	55,106
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	1	1/	5	4,789	5,451
Canning, preserving, and freezing:					
Canning and preserving, except fish	6	1,854	17	33,685	37,384
Pickles and sauces	1	1/	2	1/	2,311
Frozen foods	--	--	--	--	1/

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

MAINE, NEW HAMPSHIRE, VERMONT, CONNECTICUT, AND RHODE ISLAND

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	13	3,556	13	11,725	22,030
Biscuits, crackers, and pretzels	--	--	1	1/	1/
Confectionery and related products:					
Confectionery products	1	1/	3	14,625	15,756
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	1	1/	3	1/	3,631
Ice cream	3	1/	6	3,880	6,561
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	1	1/	4	4,091	1/
Beverages:					
Soft drinks	14	3,802	13	9,275	25,701
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	1	1/	1	1/	999
Canning, preserving, and freezing:					
Canning and preserving, except fish	3	862	3	3,418	6,002
Pickles and sauces	1	1/	1	1/	873
Frozen foods	--	--	--	--	1/

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

MASSACHUSETTS

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	18	4,881	22	32,151	44,975
Biscuits, crackers, and pretzels	--	--	5	1/	1/
Confectionery and related products:					
Confectionery products	6	1/	18	91,313	110,520
Chocolate and cocoa products	--	--	3	1/	35,159
Chewing gum	--	--	2	1/	5,033
Dairy products:					
Concentrated milk	1	1/	1	1/	1,423
Ice cream	5	1/	7	5,361	8,423
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	--	--	--	--	1/
Beverages:					
Soft drinks	15	4,092	16	14,874	29,405
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	--	--	4	1/	4,452
Canning, preserving, and freezing:					
Canning and preserving, except fish	3	992	14	30,267	31,382
Pickles and sauces	--	--	1	1/	1,438
Frozen foods	--	--	--	--	1/

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

MIDDLE ATLANTIC REGION

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	76	21,922	110	166,634	228,566
Biscuits, crackers, and pretzels	3	1,000	14	45,048	47,908
Confectionery and related products:					
Confectionery products	35	9,785	81	261,418	286,418
Chocolate and cocoa products	2	1/	16	266,162	266,738
Chewing gum	1	1/	11	61,063	61,553
Dairy products:					
Concentrated milk	3	1/	15	31,186	33,554
Ice cream	23	6,641	37	48,062	66,414
Special dairy products	3	1/	--	--	3,157
Plastic cream and bulk products	5	1,486	13	21,738	23,919
Beverages:					
Soft drinks	64	17,590	86	83,820	147,142
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	11	3,174	40	180,465	186,385
Canning, preserving, and freezing:					
Canning and preserving, except fish	14	3,959	60	179,064	188,792
Pickles and sauces	7	2,092	15	20,009	23,921
Frozen foods	2	1/	4	3,281	6,936

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

NEW YORK

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	41	11,974	51	71,303	99,235
Biscuits, crackers, and pretzels	--	--	6	24,522	25,527
Confectionery and related products:					
Confectionery products	15	1/	34	97,516	111,334
Chocolate and cocoa products	1	1/	7	90,606	90,845
Chewing gum	1	1/	6	46,428	46,901
Dairy products:					
Concentrated milk	2	1/	9	22,681	24,054
Ice cream	11	3,308	16	15,732	25,213
Special dairy products	2	1/	--	--	1/
Plastic cream and bulk products	5	1,486	8	14,343	16,110
Beverages:					
Soft drinks	25	6,676	43	37,039	61,675
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	6	1,612	29	101,411	104,943
Canning, preserving, and freezing:					
Canning and preserving, except fish	11	3,009	34	79,047	85,791
Pickles and sauces	5	1/	9	1/	9,797
Frozen foods	1	1/	2	1/	3,562

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

NEW JERSEY

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	5	1,416	19	29,607	35,392
Biscuits, crackers, and pretzels	1	1/	2	1/	8,199
Confectionery and related products:					
Confectionery products	2	1/	9	50,929	54,182
Chocolate and cocoa products	1	1/	3	9,582	9,920
Chewing gum	--	--	1	1/	1/
Dairy products:					
Concentrated milk	--	--	--	--	--
Ice cream	4	922	3	3,023	4,379
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	--	--	1	1/	1/
Beverages:					
Soft drinks	10	2,714	12	14,859	26,903
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	2	1/	6	71,021	71,909
Canning, preserving, and freezing:					
Canning and preserving, except fish	2	1/	11	35,855	37,105
Pickles and sauces	--	--	5	11,814	12,142
Frozen foods	--	--	--	--	1/

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

PENNSYLVANIA

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	30	8,532	40	65,724	93,939
Biscuits, crackers, and pretzels	2	1/	6	1/	14,182
Confectionery and related products:					
Confectionery products	18	4,840	38	112,973	120,902
Chocolate and cocoa products	--	--	6	165,973	165,973
Chewing gum	--	--	4	1/	1/
Dairy products:					
Concentrated milk	1	1/	6	8,506	9,500
Ice cream	8	2,411	18	29,307	36,822
Special dairy products	1	1/	--	--	1,094
Plastic cream and bulk products	--	--	4	1/	1/
Beverages:					
Soft drinks	29	8,201	31	31,922	58,564
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	3	1/	5	8,033	9,533
Canning, preserving, and freezing:					
Canning and preserving, except fish	1	1/	15	64,161	65,896
Pickles and sauces	2	1/	1	1/	1,982
Frozen foods	1	1/	2	1/	1/

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

NORTH CENTRAL REGION

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	136	36,539	143	230,383	324,371
Biscuits, crackers, and pretzels	7	1,992	46	101,237	105,188
Confectionery and related products:					
Confectionery products	29	8,100	97	338,552	371,312
Chocolate and cocoa products	--	--	4	24,369	24,387
Chewing gum	--	--	3	1/	43,565
Dairy products:					
Concentrated milk	12	4,908	48	137,930	156,373
Ice cream	60	16,991	41	35,632	74,211
Special dairy products	1	1/	5	1/	11,394
Plastic cream and bulk products	9	2,413	34	41,854	46,911
Beverages:					
Soft drinks	125	34,019	116	119,804	240,239
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	10	2,820	16	151,825	159,709
Canning, preserving, and freezing:					
Canning and preserving, except fish	30	8,352	65	128,331	155,420
Pickles and sauces	8	2,286	37	57,584	64,820
Frozen foods	3	1/	3	1,501	1/

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947 -Continued

OHIO

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	40	11,444	35	38,397	60,824
Biscuits, crackers, and pretzels	1	1/	6	15,391	15,878
Confectionery and related products:					
Confectionery products	3	729	4	4,879	8,378
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	1	1/	1/
Dairy products:					
Concentrated milk	4	1,267	5	9,189	10,921
Ice cream	8	2,306	12	12,719	18,100
Special dairy products	1	1/	1	1/	4,679
Plastic cream and bulk products	3	652	8	9,495	10,511
Beverages:					
Soft drinks	27	7,230	24	25,374	44,278
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	--	--	2	1/	7,191
Canning, preserving, and freezing:					
Canning and preserving, except fish	1	1/	6	19,321	21,740
Pickles and sauces	1	1/	7	10,893	13,373
Frozen foods	--	--	--	--	1/

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

INDIANA

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	11	2,784	14	9,963	18,901
Biscuits, crackers, and pretzels	--	--	3	4,816	4,894
Confectionery and related products:					
Confectionery products	2	1/	6	13,088	14,478
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	--	--	1	1/	1,460
Ice cream	5	1,510	3	2,733	7,361
Special dairy products	--	--	--	--	307
Plastic cream and bulk products	--	--	8	13,489	13,698
Beverages:					
Soft drinks	9	2,180	15	12,475	22,823
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	--	--	--	--	425
Canning, preserving, and freezing:					
Canning and preserving, except fish	4	1,229	10	25,255	28,623
Pickles and sauces	1	1/	14	11,564	12,249
Frozen foods	--	--	--	--	--

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

ILLINOIS

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	30	7,766	32	51,705	69,253
Biscuits, crackers, and pretzels	2	1/	9	25,806	26,941
Confectionery and related products:					
Confectionery products	11	2,923	58	264,234	281,263
Chocolate and cocoa products	--	--	2	1/	7,136
Chewing gum	--	--	2	1/	42,493
Dairy products:					
Concentrated milk	1	1/	7	11,574	22,381
Ice cream	12	3,342	11	9,998	16,460
Special dairy products	--	--	1	1/	1,032
Plastic cream and bulk products	1	1/	2	1/	4,047
Beverages:					
Soft drinks	22	5,849	26	26,514	45,527
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	5	1,492	7	91,304	94,047
Canning, preserving, and freezing:					
Canning and preserving except fish	3	1/	18	39,127	41,726
Pickles and sauces	1	1/	4	12,523	13,303
Frozen foods	--	--	--	--	--

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

MICHIGAN

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	10	2,539	16	86,289	96,156
Biscuits, crackers, and pretzels	1	1/	6	13,048	13,709
Confectionery and related products:					
Confectionery products	1	1/	3	3,007	4,054
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	1/
Dairy products:					
Concentrated milk	4	1,101	10	30,901	32,157
Ice cream	7	1,891	7	3,213	7,794
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	1	1/	7	5,709	6,668
Beverages:					
Soft drinks	16	4,396	14	24,426	38,093
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	3	1/	2	1/	3,639
Canning, preserving, and freezing					
Canning and preserving, except fish	10	2,586	13	24,369	27,754
Pickles and sauces	1	1/	3	10,586	11,254
Frozen foods	1	1/	3	1/	3,944

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

WISCONSIN

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	10	2,561	9	7,402	15,994
Biscuits, crackers, and pretzels	--	--	4	4,893	4,907
Confectionery and related products:					
Confectionery products	3	888	6	7,749	9,590
Chocolate and cocoa products	--	--	2	1/	17,251
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	--	--	17	70,093	70,657
Ice cream	1	1/	2	1/	5,425
Special dairy products	--	--	3	1/	5,078
Plastic cream and bulk products	2	1/	6	7,725	8,869
Beverages:					
Soft drinks	6	1,703	7	1/	17,547
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	1	1/	--	--	413
Canning, preserving, and freezing:					
Canning and preserving, except fish	8	2,283	5	1/	15,281
Pickles and sauces	1	1/	4	1/	8,207
Frozen foods	--	--	--	--	816

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

MINNESOTA

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	10	2,840	7	4,944	11,949
Biscuits, crackers, and pretzels	1	1/	3	6,096	6,388
Confectionery and related products:					
Confectionery products	4	1,268	5	1/	9,952
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	--	--	4	1/	7,145
Ice cream	9	1,682	1	1/	5,107
Special dairy products	--	--	--	--	--
Plastic cream and bulk products	--	--	1	1/	1/
Beverages:					
Soft drinks	7	2,060	7	5,488	13,671
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	--	--	--	--	1/
Canning, preserving, and freezing:					
Canning and preserving, except fish	4	1,070	6	5,432	8,940
Pickles and sauces	--	--	1	1/	941
Frozen foods	2	1/	--	--	485

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

IOWA AND MISSOURI

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	14	3,635	25	26,429	36,461
Biscuits, crackers, and pretzels	1	1/	10	24,648	25,468
Confectionery and related products:					
Confectionery products	4	1,050	13	36,513	39,867
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	2	1/	--	--	2,872
Ice cream	13	3,605	1	2,800	10,011
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	1	1/	1	1/	1,215
Beverages:					
Soft drinks	25	6,894	18	15,717	38,257
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	--	--	5	52,747	53,130
Canning, preserving, and freezing:					
Canning and preserving, except fish	--	--	5	8,511	9,859
Pickles and sauces	3	887	1	1/	2,994
Frozen foods	--	--	--	--	365

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

NORTH DAKOTA, SOUTH DAKOTA, AND NEBRASKA

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	6	1,667	3	1/	7,886
Biscuits, crackers, and pretzels	1	1/	4	1/	1/
Confectionery and related products:					
Confectionery products	--	--	2	1/	1/
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	--	--	--	--	140
Ice cream	2	1/	1	1/	2,163
Special dairy products	--	--	--	--	--
Plastic cream and bulk products	1	1/	--	--	1/
Beverages:					
Soft drinks	6	1,743	2	1/	10,101
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	1	1/	--	--	1/
Canning, preserving, and freezing:					
Canning and preserving, except fish	--	--	1	1/	1/
Pickles and sauces	--	--	--	--	1/
Frozen foods	--	--	--	--	--

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

KANSAS

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	5	1,302	2	1/	6,947
Biscuits, crackers, and pretzels	--	--	1	1/	1/
Confectionery and related products:					
Confectionery products	1	1/	--	--	1/
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	1	1/	4	8,347	8,640
Ice cream	3	955	--	--	1,790
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	--	--	1	1/	945
Beverages:					
Soft drinks	7	1,964	3	2,298	9,942
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	--	--	--	--	389
Canning, preserving, and freezing:					
Canning and preserving, except fish	--	--	1	1/	1/
Pickles and sauces	--	--	3	1/	1/
Frozen foods	--	--	--	--	--

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

SOUTHERN REGION

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	102	28,244	121	111,471	178,096
Biscuits, crackers, and pretzels	8	2,257	22	38,178	41,597
Confectionery and related products:					
Confectionery products	34	9,245	52	75,361	94,829
Chocolate and cocoa products	--	--	--	--	1/
Chewing gum	--	--	2	1/	1/
Dairy products:					
Concentrated milk	7	1,881	7	10,228	14,064
Ice cream	43	12,147	29	17,119	48,293
Special dairy products	1	1/	2	1/	6,425
Plastic cream and bulk products	2	1/	7	7,291	8,263
Beverages:					
Soft drinks	209	58,638	158	120,234	287,033
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	3	1/	15	279,931	282,468
Canning, preserving, and freezing:					
Canning and preserving, except fish	35	10,245	54	100,704	124,664
Pickles and sauces	8	2,230	12	16,140	20,491
Frozen foods	9	2,386	3	1,408	6,163

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

MARYLAND, DELAWARE, AND DISTRICT OF COLUMBIA

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	12	3,315	15	15,148	22,799
Biscuits, crackers, and pretzels	--	--	2	1/	1/
Confectionery and related products:					
Confectionery products	4	1,090	6	5,599	7,641
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	2	1/	--	--	1/
Ice cream	1	1/	8	4,848	6,411
Special dairy products	--	--	1	1/	1/
Plastic cream and bulk products	--	--	2	1/	1,644
Beverages:					
Soft drinks	6	1,887	16	15,567	22,257
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	--	--	2	1/	75,487
Canning, preserving, and freezing:					
Canning and preserving, except fish	4	1/	7	15,237	1/
Pickles and sauces	1	1/	2	1/	3,355
Frozen foods	2	1/	--	--	691

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

VIRGINIA AND WEST VIRGINIA

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	11	3,492	16	11,673	20,191
Biscuits, crackers, and pretzels	--	--	1	1/	1/
Confectionery and related products:					
Confectionery products	3	841	7	7,278	9,272
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	2	1/	1	1/	1/
Ice cream	3	1/	5	1/	4,960
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	1	1/	3	4,571	4,933
Beverages:					
Soft drinks	25	7,068	21	16,729	37,184
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	--	--	2	1/	3,332
Canning, preserving, and freezing:					
Canning and preserving, except fish	1	1/	5	21,839	23,422
Pickles and sauces	2	1/	1	1/	1,180
Frozen foods	2	1/	--	--	749

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

NORTH CAROLINA, SOUTH CAROLINA, GEORGIA, AND FLORIDA

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	28	7,875	30	32,639	47,627
Biscuits, crackers, and pretzels	3	1/	3	8,390	9,557
Confectionery and related products:					
Confectionery products	9	2,654	16	21,763	27,145
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	--	--	--	--	1/
Ice cream	15	4,996	9	5,271	13,611
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	--	--	--	--	1/
Beverages:					
Soft drinks	58	16,561	46	36,774	81,390
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	1	1/	5	79,022	79,646
Canning, preserving, and freezing:					
Canning and preserving, except fish	22	6,252	25	35,724	48,317
Pickles and sauces	2	1/	4	5,143	6,349
Frozen foods	--	--	1	1/	1/

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

KENTUCKY, TENNESSEE, ALABAMA, AND MISSISSIPPI

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	27	7,044	24	22,794	36,356
Biscuits, crackers, and pretzels	3	830	6	6,071	7,218
Confectionery and related products:					
Confectionery products	5	1,311	11	26,430	27,741
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	1	1/	1/
Dairy products:					
Concentrated milk	2	1/	3	7,719	8,735
Ice cream	9	2,782	1	1/	8,197
Special dairy products	1	1/	--	--	1/
Plastic cream and bulk products	--	--	1	1/	1/
Beverages:					
Soft drinks	45	12,632	35	23,543	60,907
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	1	1/	2	1/	16,345
Canning, preserving, and freezing:					
Canning and preserving, except fish	1	1/	7	11,943	1/
Pickles and sauces	--	--	3	5,275	5,488
Frozen foods	2	--	1	1/	1,569

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

ARKANSAS, LOUISIANA, OKLAHOMA, AND TEXAS

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	24	6,518	36	29,217	51,123
Biscuits, crackers, and pretzels	2	1/	10	17,426	18,421
Confectionery and related products:					
Confectionery products	13	3,349	12	14,291	23,030
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	1	1/	1/
Dairy products:					
Concentrated milk	1	1/	3	1/	2,582
Ice cream	15	3,973	6	3,706	15,114
Special dairy products	--	--	1	1/	1/
Plastic cream and bulk products	1	1/	1	1/	1,210
Beverages:					
Soft drinks	75	20,490	40	27,621	85,295
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	1	1/	4	106,537	107,658
Canning, preserving, and freezing:					
Canning and preserving, except fish	7	2,054	10	15,961	22,470
Pickles and sauces	3	781	2	1/	4,119
Frozen foods	3	806	1	1/	1/

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

WESTERN REGION

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	60	17,130	57	57,989	102,537
Biscuits, crackers, and pretzels	5	1,215	16	33,323	35,557
Confectionery and related products:					
Confectionery products	15	4,400	37	52,685	67,396
Chocolate and cocoa products	-	-	4	1/	1/
Chewing gum	-	-	-	-	-
Dairy products:					
Concentrated milk	5	1,241	10	18,793	20,793
Ice cream	26	7,366	14	23,630	38,188
Special dairy products	-	-	-	-	7,909
Plastic cream and bulk products	3	767	6	6,751	7,850
Beverages:					
Soft drinks	41	11,325	37	33,302	71,267
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	7	2,303	11	54,409	57,878
Canning, preserving, and freezing:					
Canning and preserving, except fish	28	8,114	125	291,891	307,146
Pickles and sauces	8	2,214	12	39,290	44,286
Frozen foods	12	3,179	12	12,998	20,863

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

MONTANA, IDAHO, WYOMING, COLORADO, NEW MEXICO, ARIZONA, AND UTAH

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	9	2,979	8	5,157	17,507
Biscuits, crackers, and pretzels	--	--	3	5,029	5,064
Confectionery and related products:					
Confectionery products	2	1/	6	6,576	9,358
Chocolate and cocoa products	--	--	--	--	--
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	--	--	1	1/	611
Ice cream	9	2,574	1	1/	6,505
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	1	1/	--	--	463
Beverages:					
Soft drinks	14	4,076	7	4,753	19,041
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	--	--	--	--	179
Canning, preserving, and freezing:					
Canning and preserving, except fish	4	1,078	6	4,827	8,496
Pickles and sauces	1	1/	1	1/	1,798
Frozen foods	--	--	1	1/	1,122

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

WASHINGTON AND OREGON

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	17	4,619	13	11,233	23,472
Biscuits, crackers, and pretzels	3	1/	5	8,089	8,949
Confectionery and related products:					
Confectionery products	2	1/	6	8,472	11,072
Chocolate and cocoa products	--	--	1	1/	1/
Chewing gum	--	--	--	--	--
Dairy products:					
Concentrated milk	1	1/	2	1/	2,549
Ice cream	4	905	4	1/	5,426
Special dairy products	--	--	--	--	--
Plastic cream and bulk products	--	--	1	1/	629
Beverages:					
Soft drinks	7	1,743	6	4,197	11,231
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	2	1/	2	1/	10,645
Canning, preserving, and freezing:					
Canning and preserving, except fish	15	4,488	30	54,633	60,751
Pickles and sauces	3	1/	2	1/	4,721
Frozen foods	11	1/	11	1/	18,514

1/ Withheld to avoid disclosing operations of individual companies.

Table 7.--Industrial sugar consumption, by selected industries and size classes, 1947-Continued

CALIFORNIA

Industry	Establishments consuming 200,000 to 400,000 pounds of sugar a year		Establishments consuming more than 400,000 pounds of sugar a year		Total reported consumption by all establishments in the industry
	Number	1,000 lb.	Number	1,000 lb.	1,000 lb.
Bakery products:					
Bread and other bakery products	34	9,532	36	41,599	61,558
Biscuits, crackers, and pretzels	2	1/	8	20,205	21,544
Confectionery and related products:					
Confectionery products	11	3,271	25	37,637	46,966
Chocolate and cocoa products	--	--	3	1/	1/
Chewing gum	--	--	--	--	1/
Dairy products:					
Concentrated milk	4	1/	7	16,505	17,633
Ice cream	13	3,887	9	19,571	26,257
Special dairy products	--	--	--	--	1/
Plastic cream and bulk products	2	1/	5	1/	6,758
Beverages:					
Soft drinks	20	5,506	24	24,352	40,995
Miscellaneous food preparations:					
Flavoring extracts and flavoring sirups	5	1/	9	1/	47,054
Canning, preserving, and freezing:					
Canning and preserving, except fish	9	2,548	89	232,431	237,899
Pickles and sauces	4	1,220	9	34,931	37,767
Frozen foods	1	1/	--	--	1,227

1/ Withheld to avoid disclosing operations of individual companies.

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